Geomorphological and structural characterization of the seafloor of the Iquique Ridge in northern Chile, using multibeam bathymetry.

Speaker

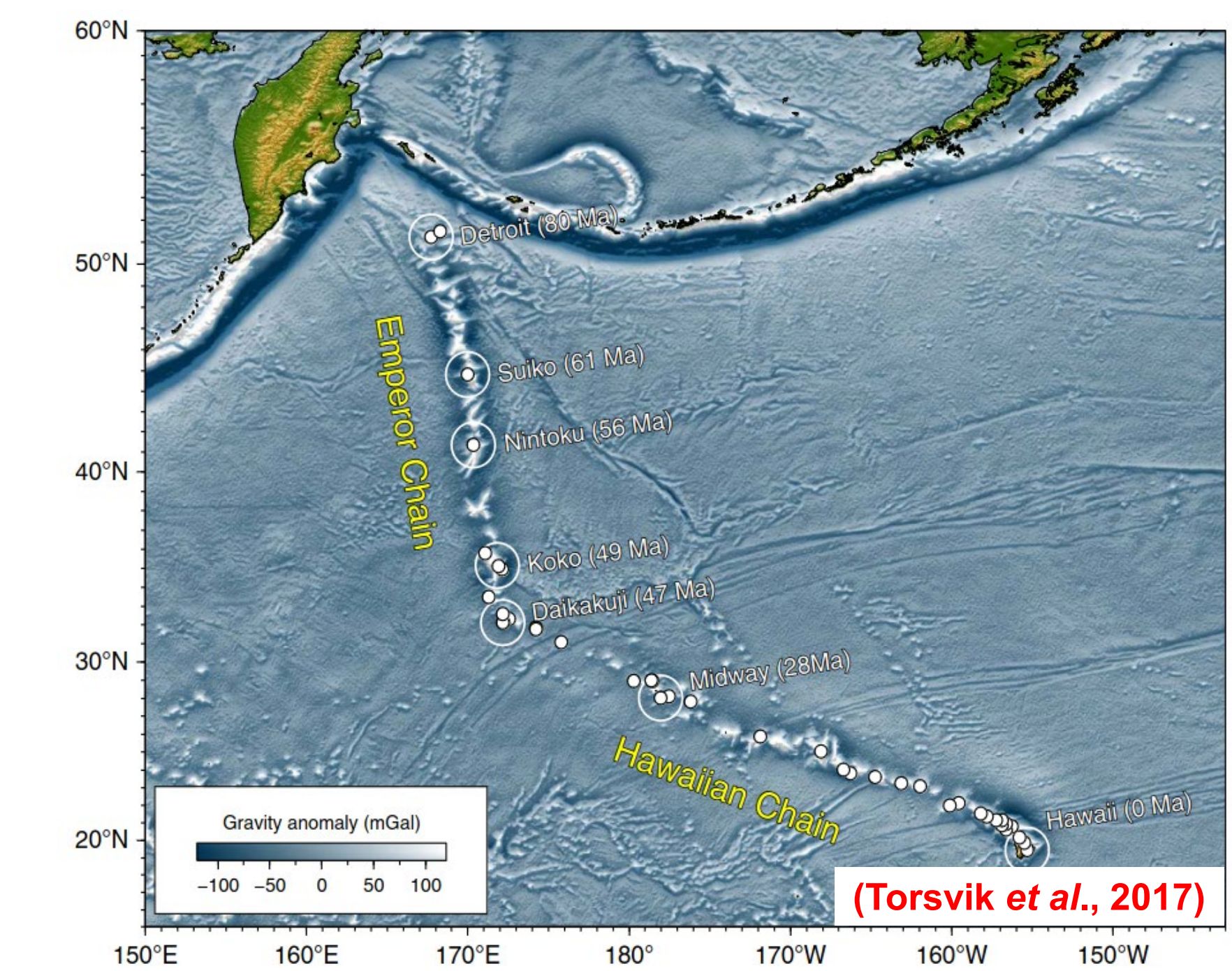
Catalina García-Jove Contreras

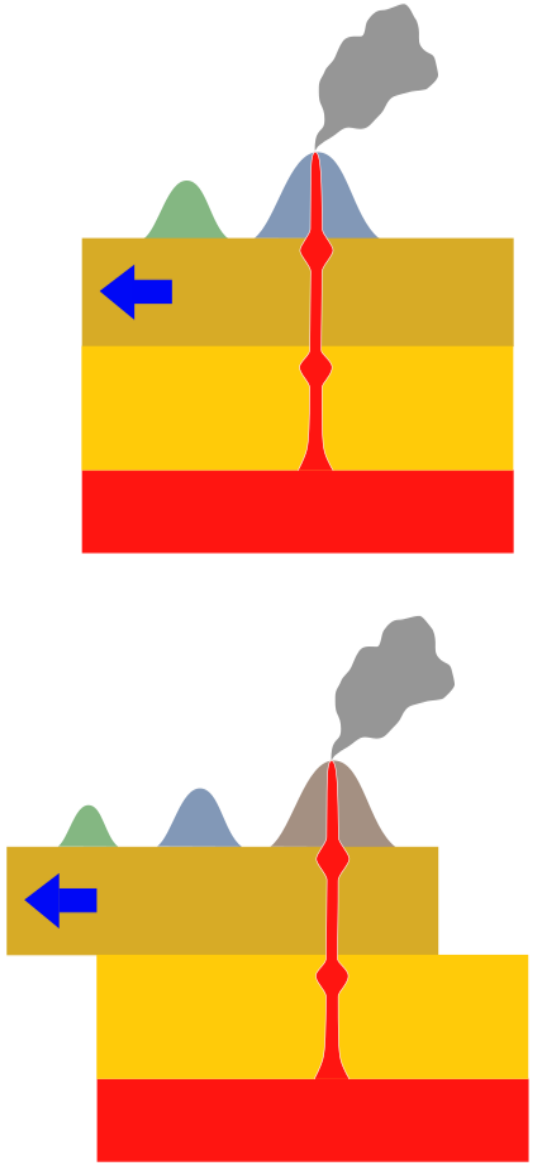
Geologist & Master of Oceanography

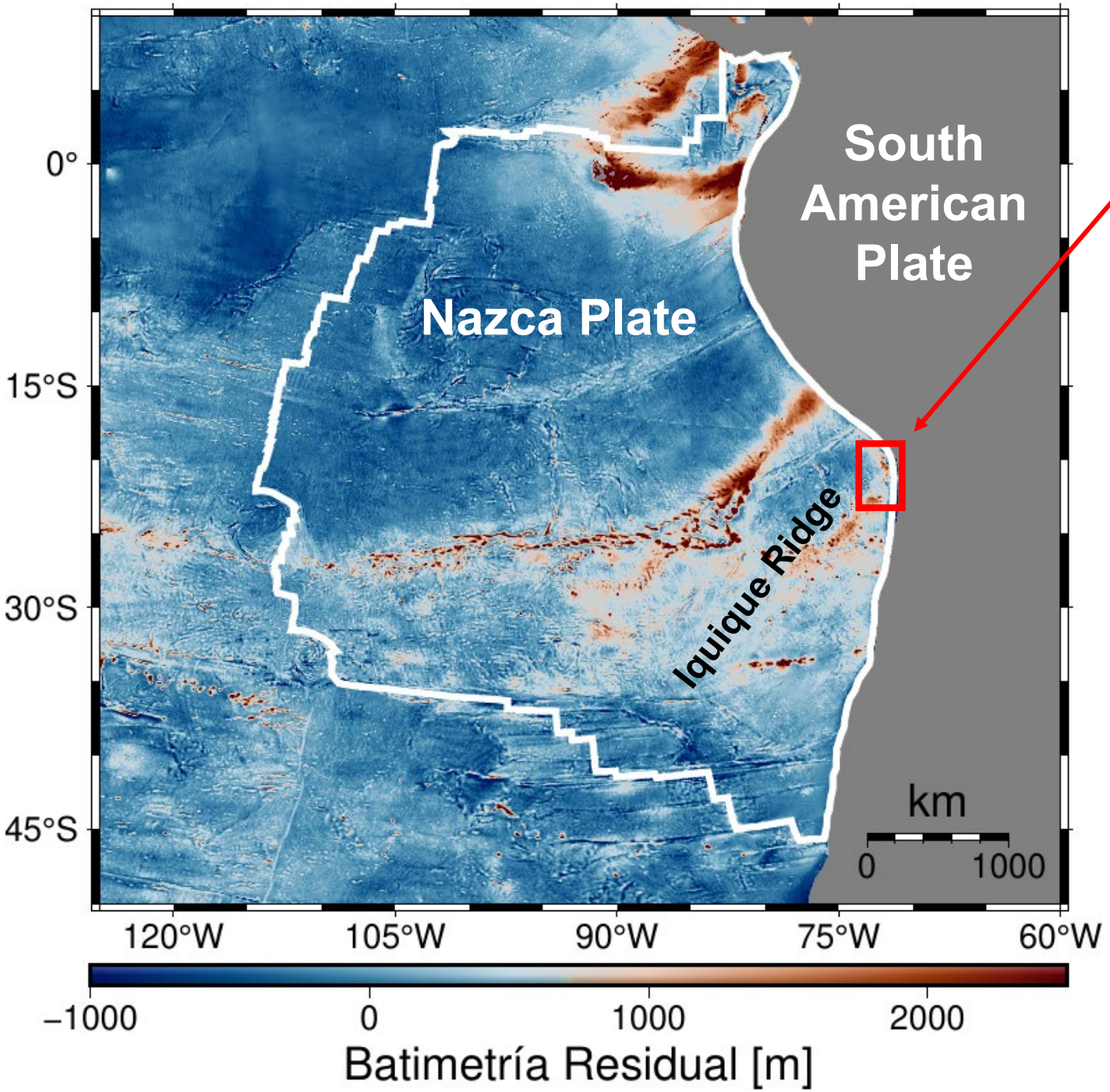
¿What is a Ridge?

Ridge: Elongated and elevated structure of variable complexity (length > width) **(Dove *et al*., 2020).**

Example of a Ridge





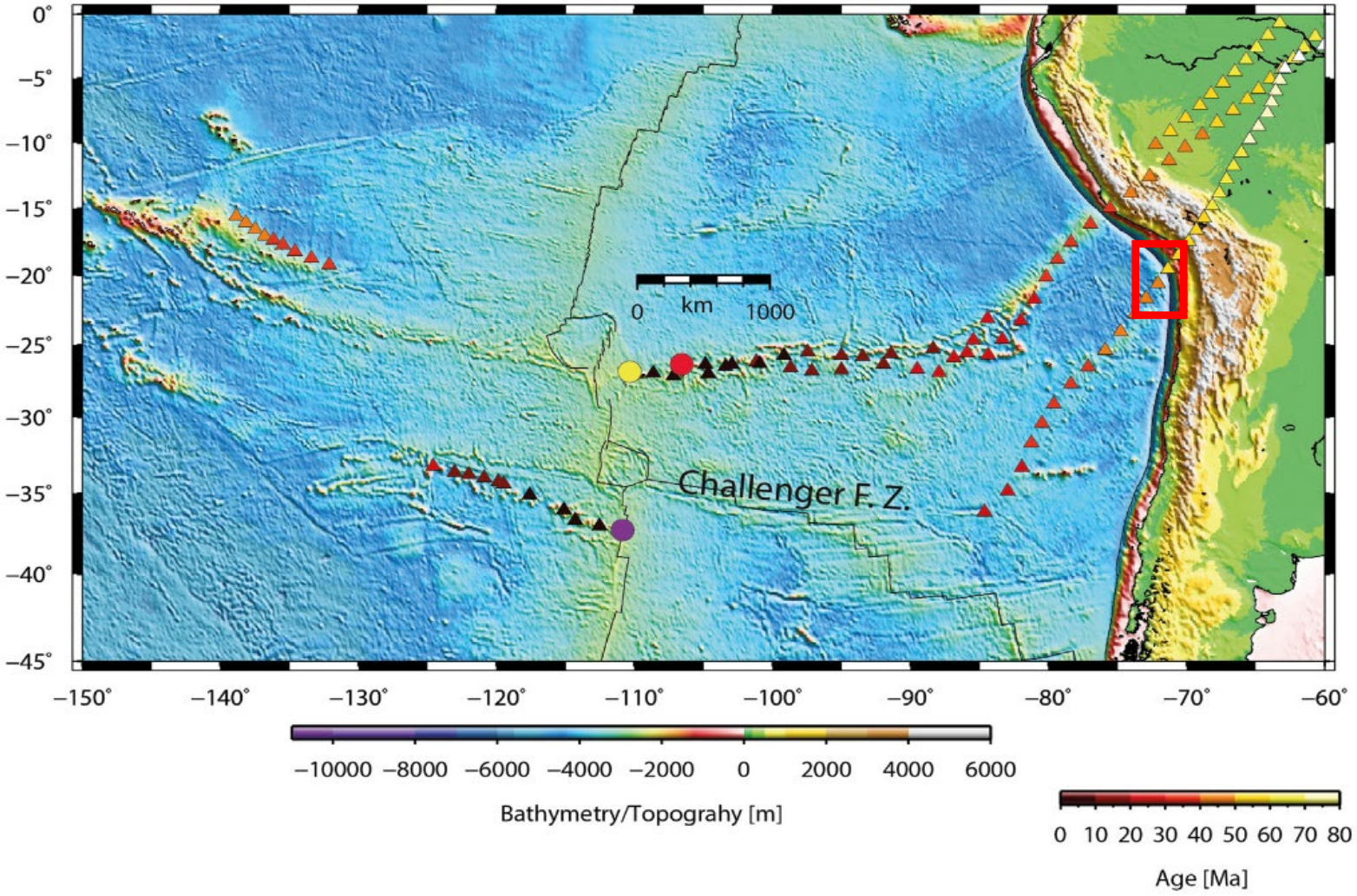


Iquique Ridge:

- > 1.000 km extension
- Subduct in the curvature of the Arica Bend
- Composed mainly of seamounts
- Born from a “hot spot”

Map created from data on the [earthdynamics.org] website.

Origin of the Iquique Ridge



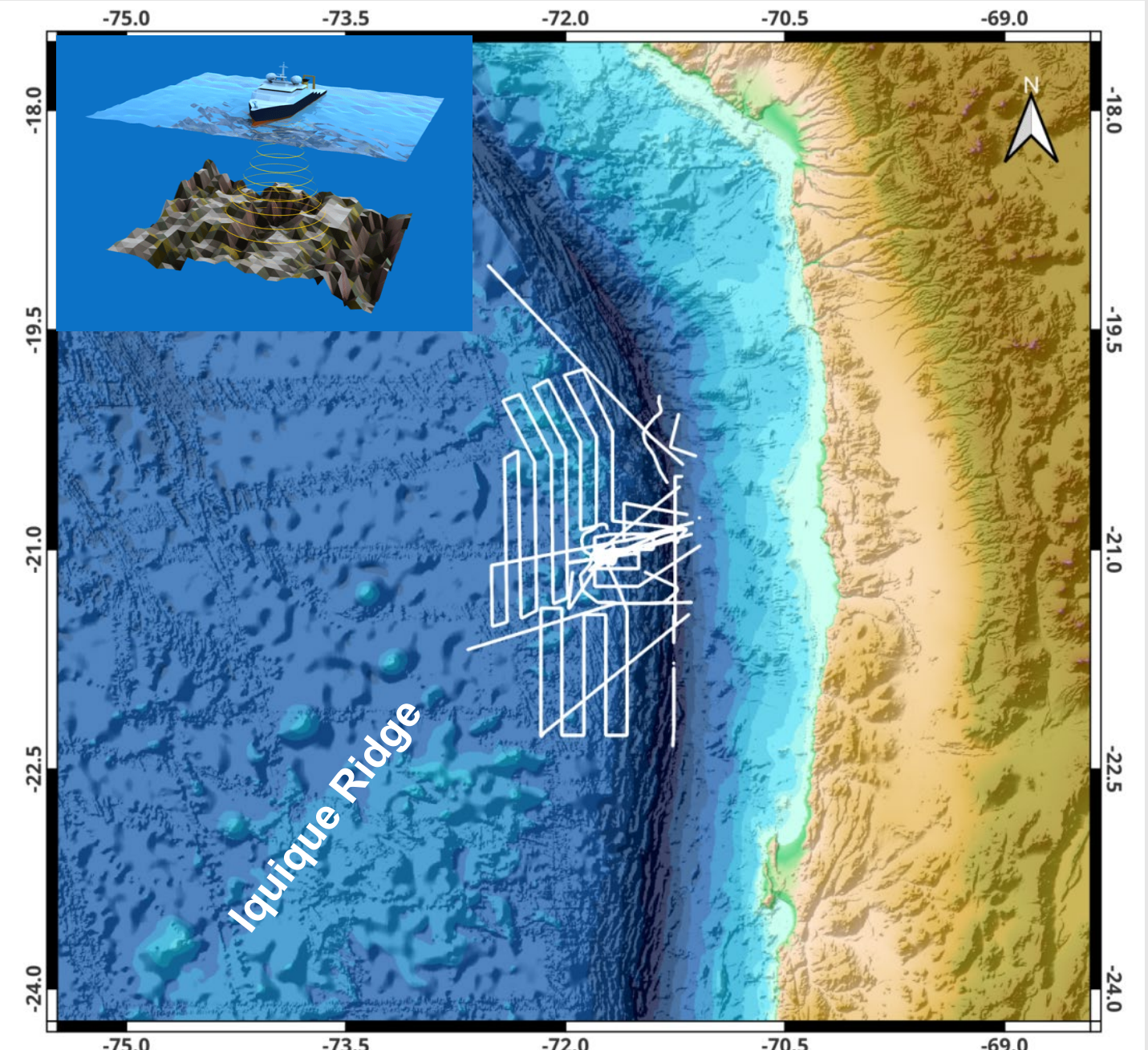
● : Eastern Hotspot/Easter Island Tuamotu Plateau (Pacific branch) and Easter Seamount Chain (Nazca branch)

● : Salas y Gómez Hotspot/Easter Seamount Chain and Nazca Ridge

(Bello-González *et al.*, 2018)

● : Foundation Hotspot/Foundation Chain (Pacific branch) and Iquique Ridge (Nazca branch)

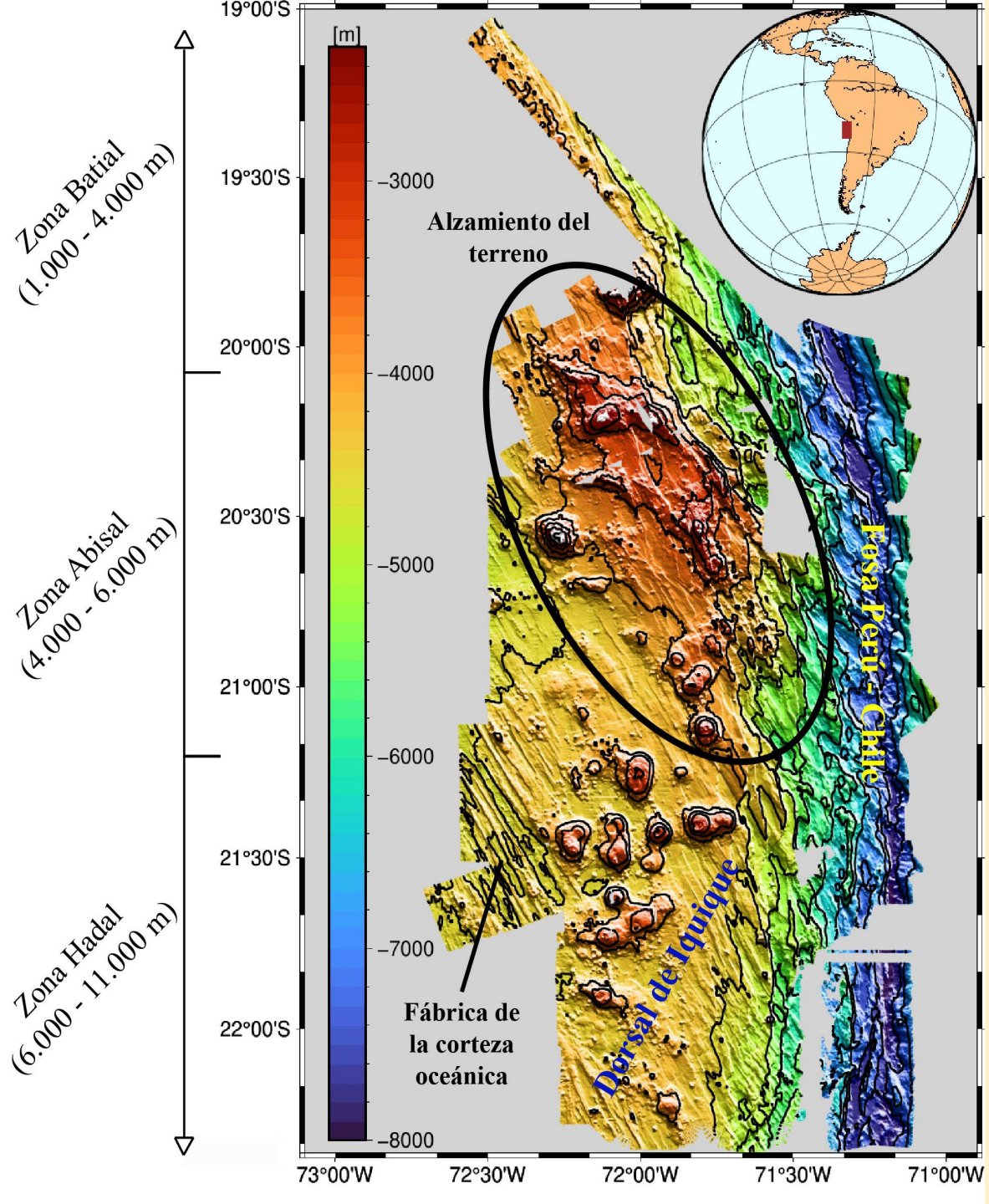
Multibeam Bathymetry Campaign

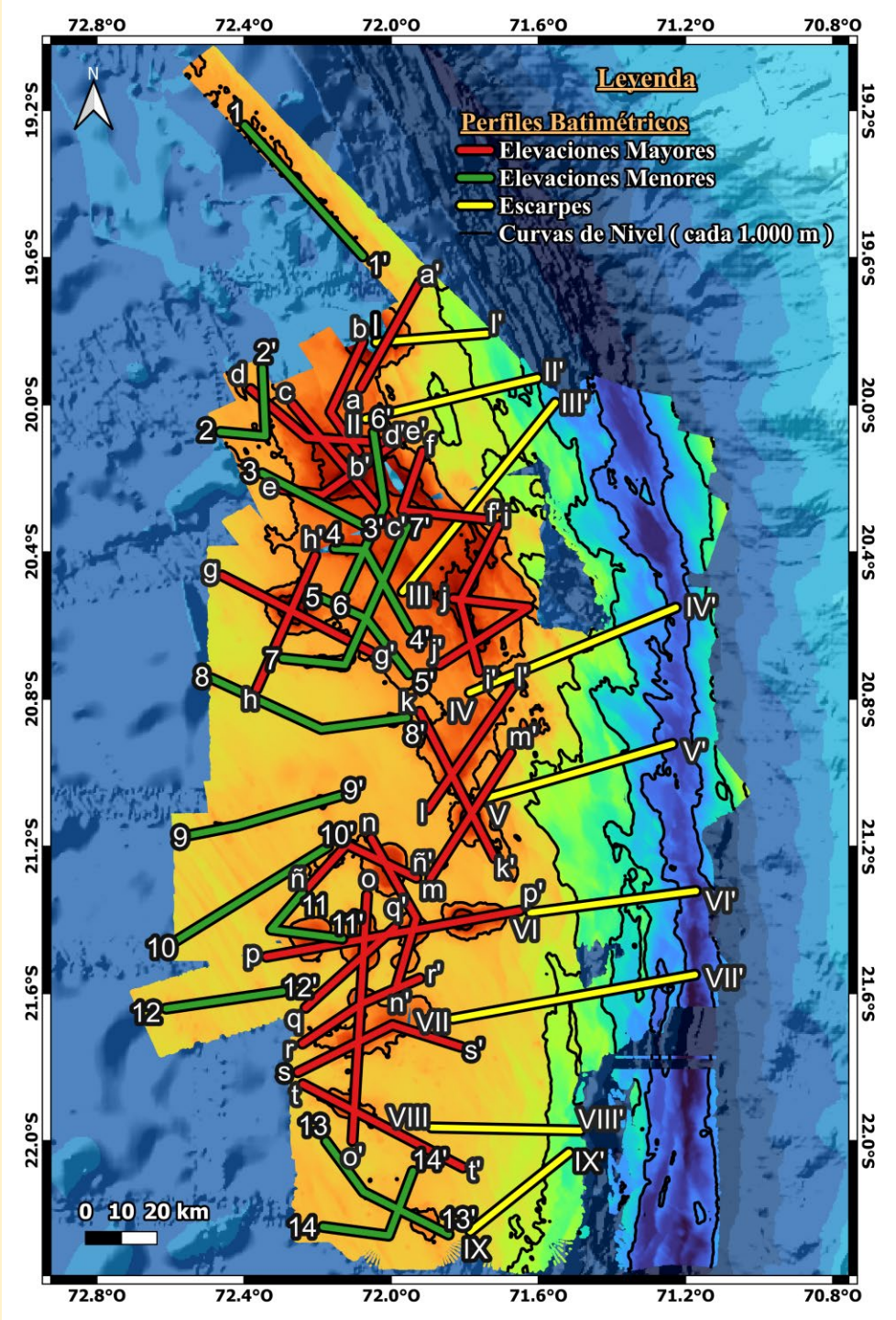


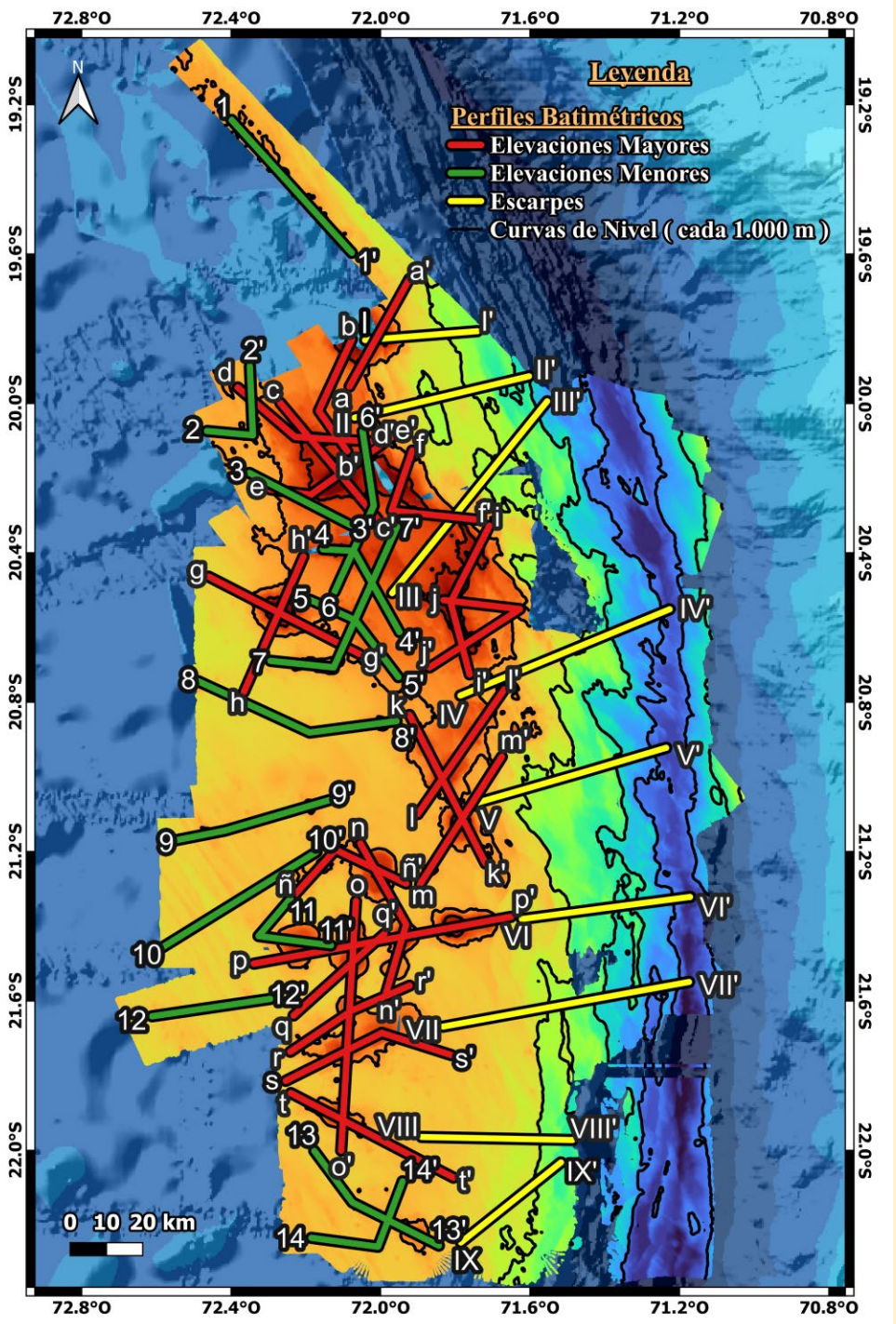
- **SONNE Research Vessel**
- Campaigns **SO244** (year 2015) and **SO288** (year 2022).
- **Kongsberg EM122 multibeam echosounder.**
- **12 kHz frequency.**
- Range depth from 20m below the transducers **to the maximum ocean depth (11,000m approx.).**
- Raw data delivered.

Background image from GEBCO [https://download.gebco.net].

Results


Zona Batial
(1.000 - 4.000 m)
Zona Abisal
(4.000 - 6.000 m)
Zona Hadal
(6.000 - 11.000 m)
[m]
-3000
-4000
-5000
-6000
-7000
-8000
Alzamiento del terreno
Fosa Perú - Chile
Dorsal de Iquique
Fábrica de la corteza oceánica
19°00'S
19°30'S
20°00'S
20°30'S
21°00'S
21°30'S
22°00'S
73°00'W
72°30'W
72°00'W
71°30'W
71°00'W


Leyenda
Perfiles Batimétricos
Elevaciones Mayores
Elevaciones Menores
Escarpes
Curvas de Nivel (cada 1.000 m)
N
0 10 20 km
72.8°O
72.4°O
72.0°O
71.6°O
71.2°O
70.8°O
19.2°S
19.6°S
20.0°S
20.4°S
20.8°S
21.2°S
21.6°S
22.0°S



Map of Profile Locations

Red Profiles: Seeks to analyze higher elevations over 1,000 m high.

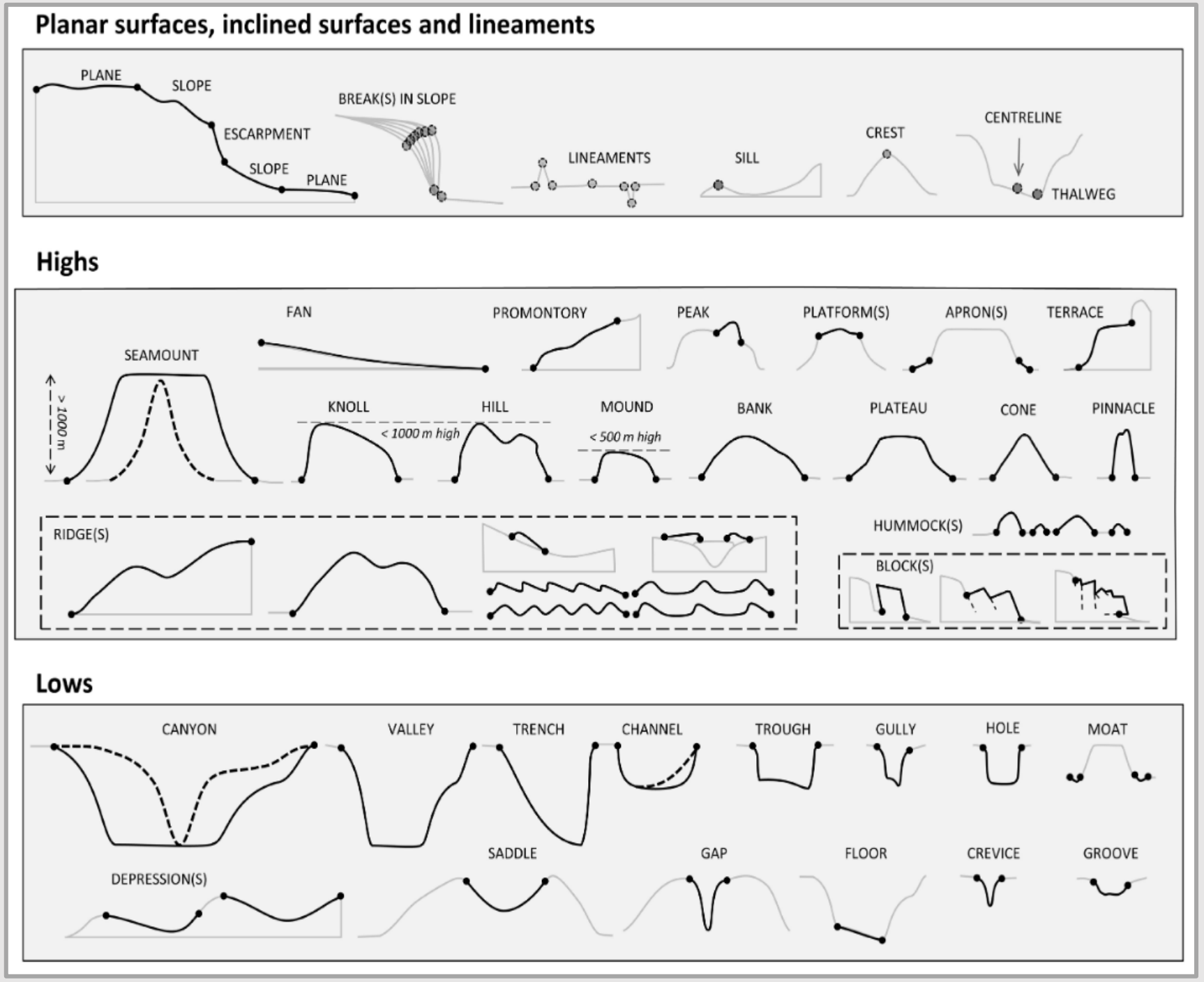
Green Profiles: Seeks to analyze lower elevations below 1,000 m high.

Yellow Profiles: Seeks to analyze the normal fault scarps of the Peru-Chile Trench.

*** All profiles have the same scale with vertical exaggeration of 10.**

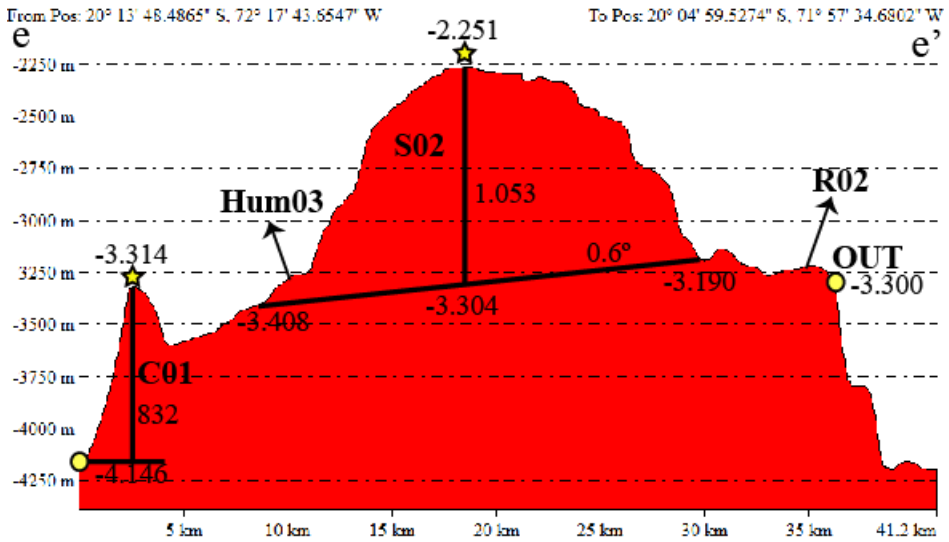
Morphological Identification

Using the profiles, different types of structures can be identified using the Glossary of Dove et al. (2020).

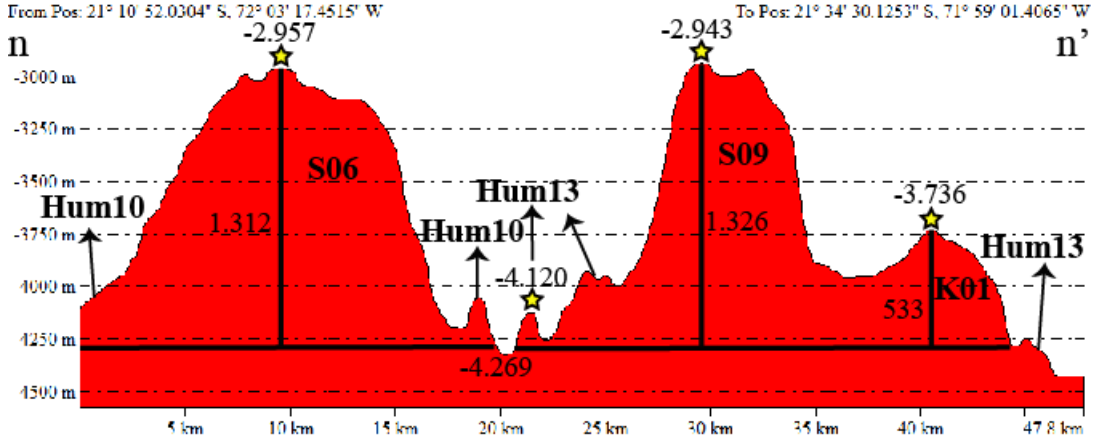


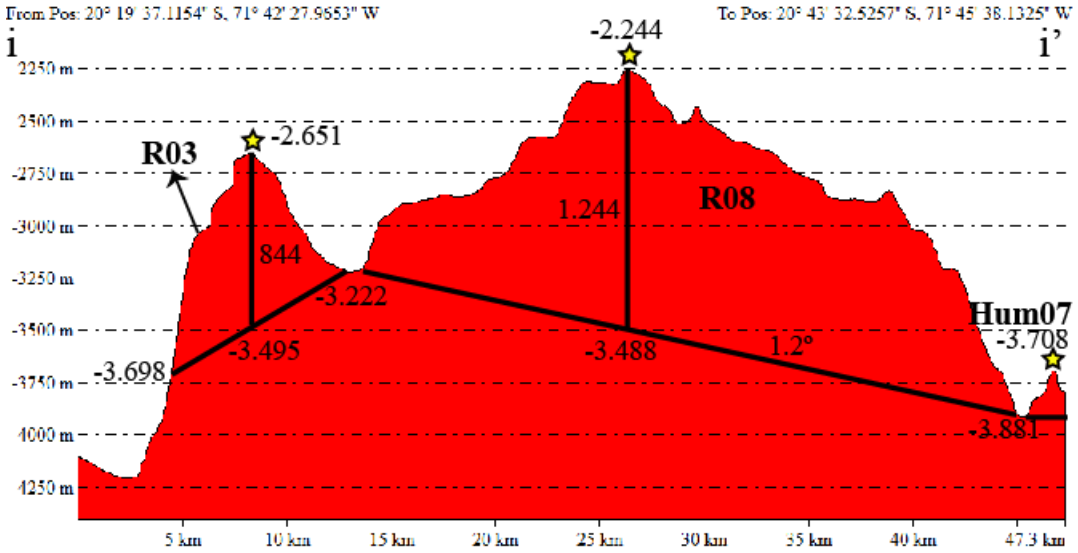
(Dove *et al.*, 2020)

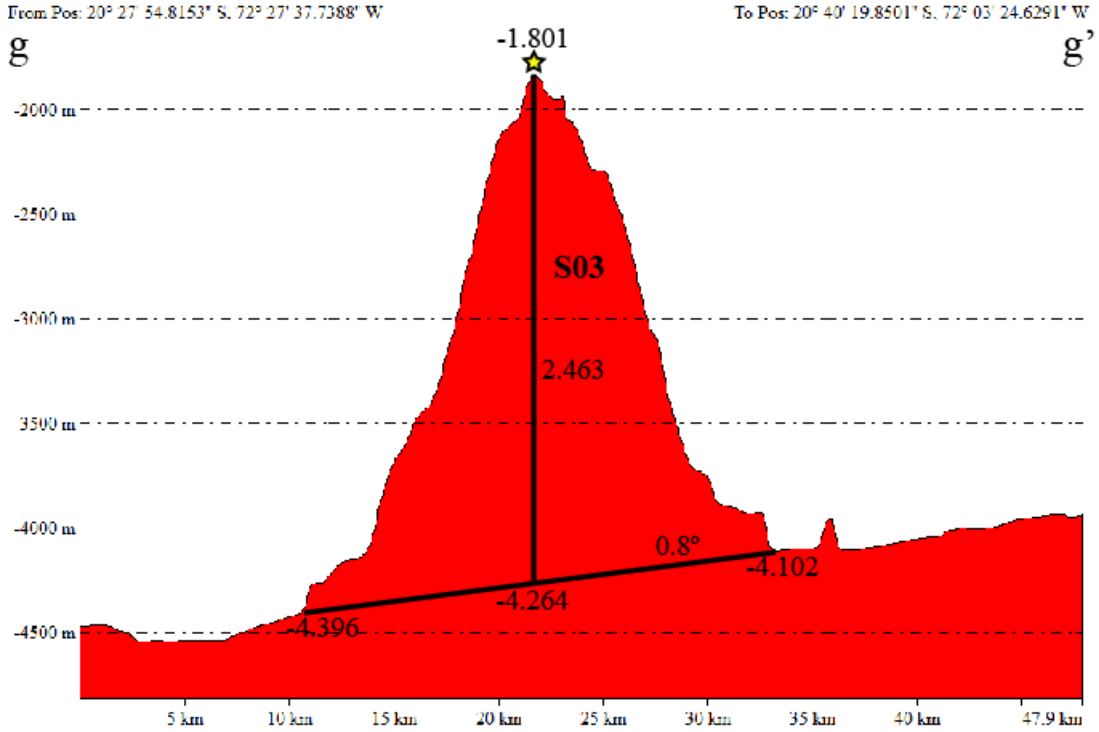
Higher elevations (Δz > 1.000 m)



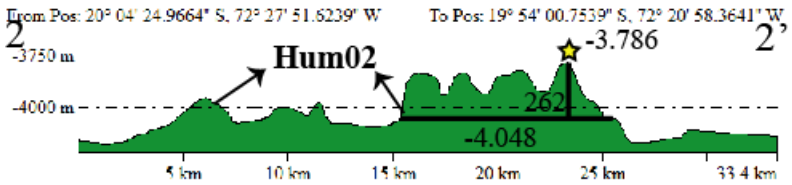
EV=10

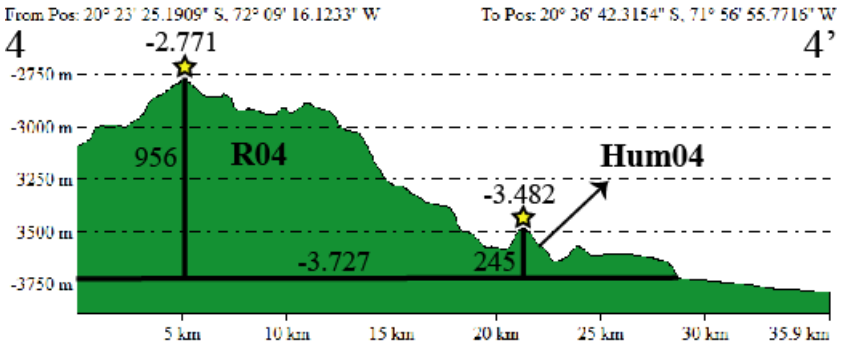


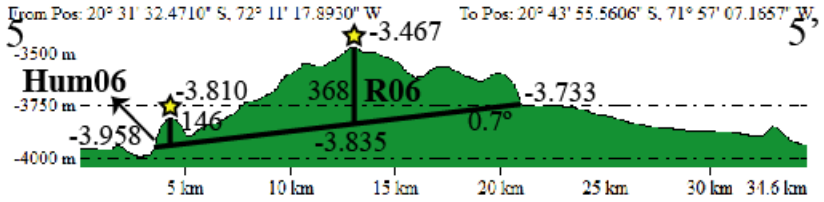


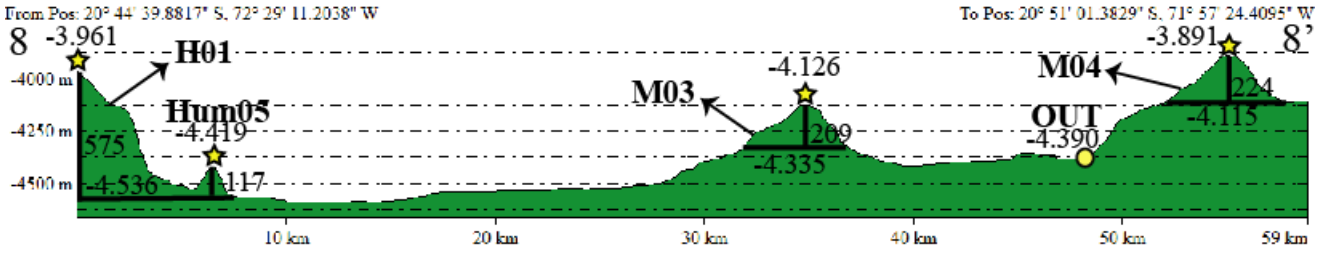


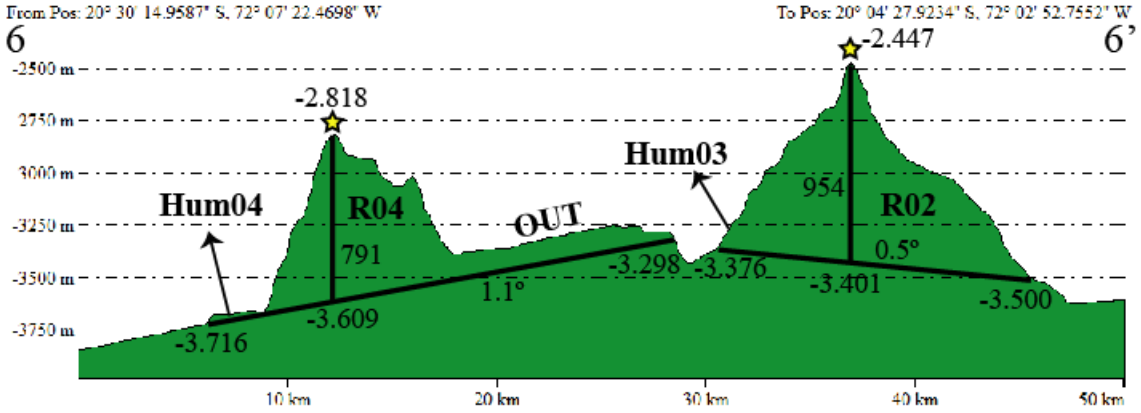
Lower elevations (Δz < 1.000 m)



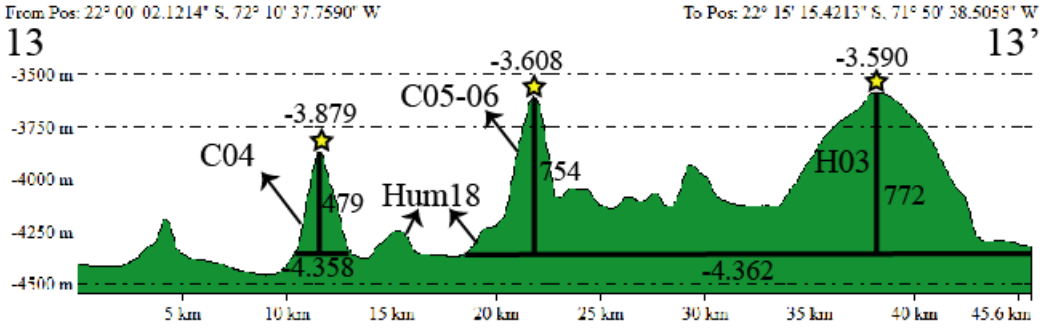


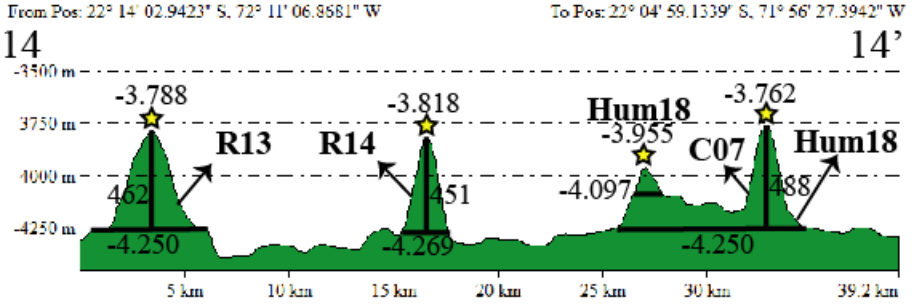




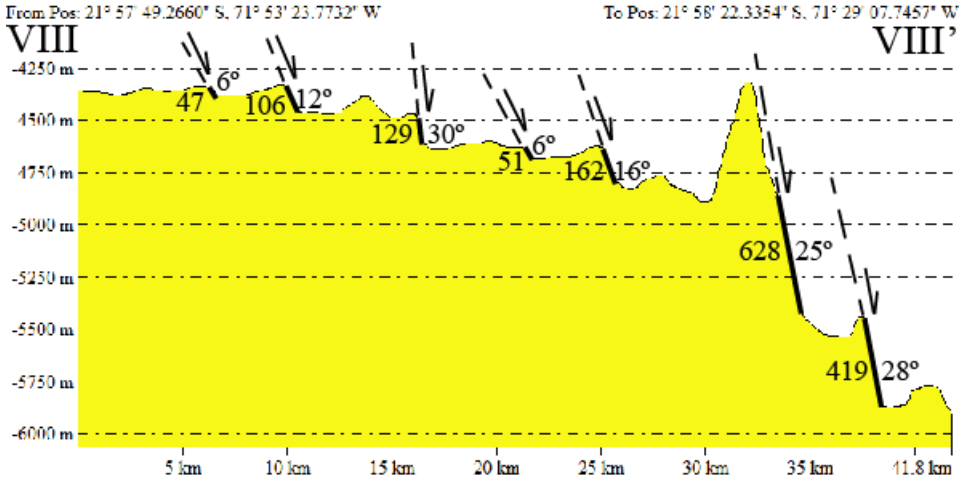


EV=10





Normal fault scarps of the Perú-Chile Trench



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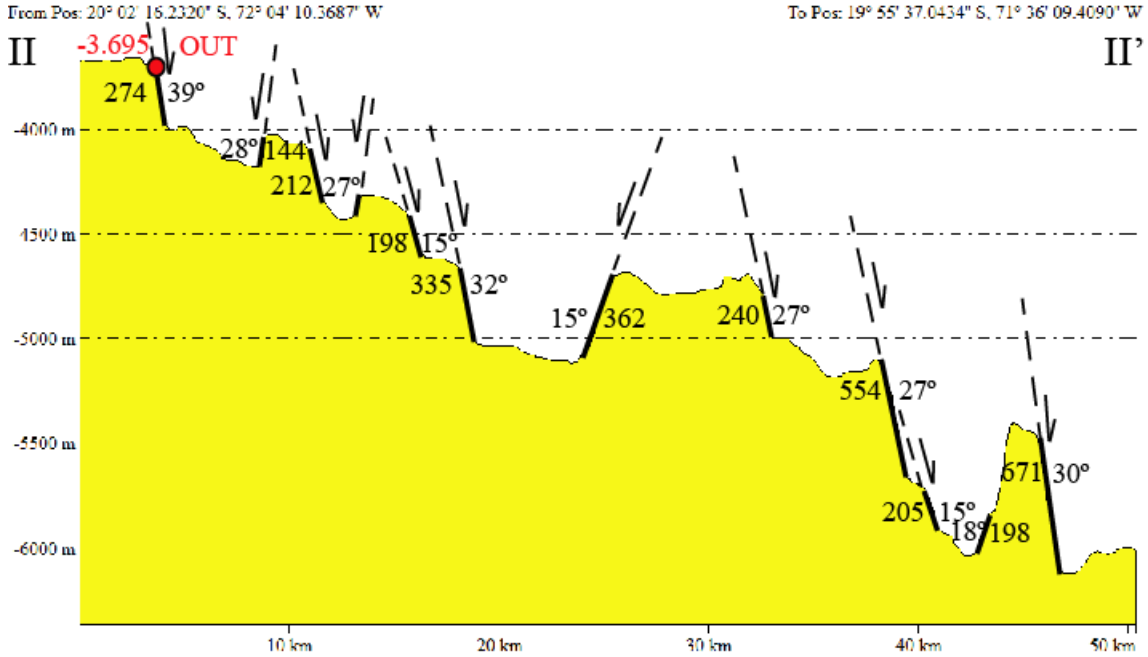
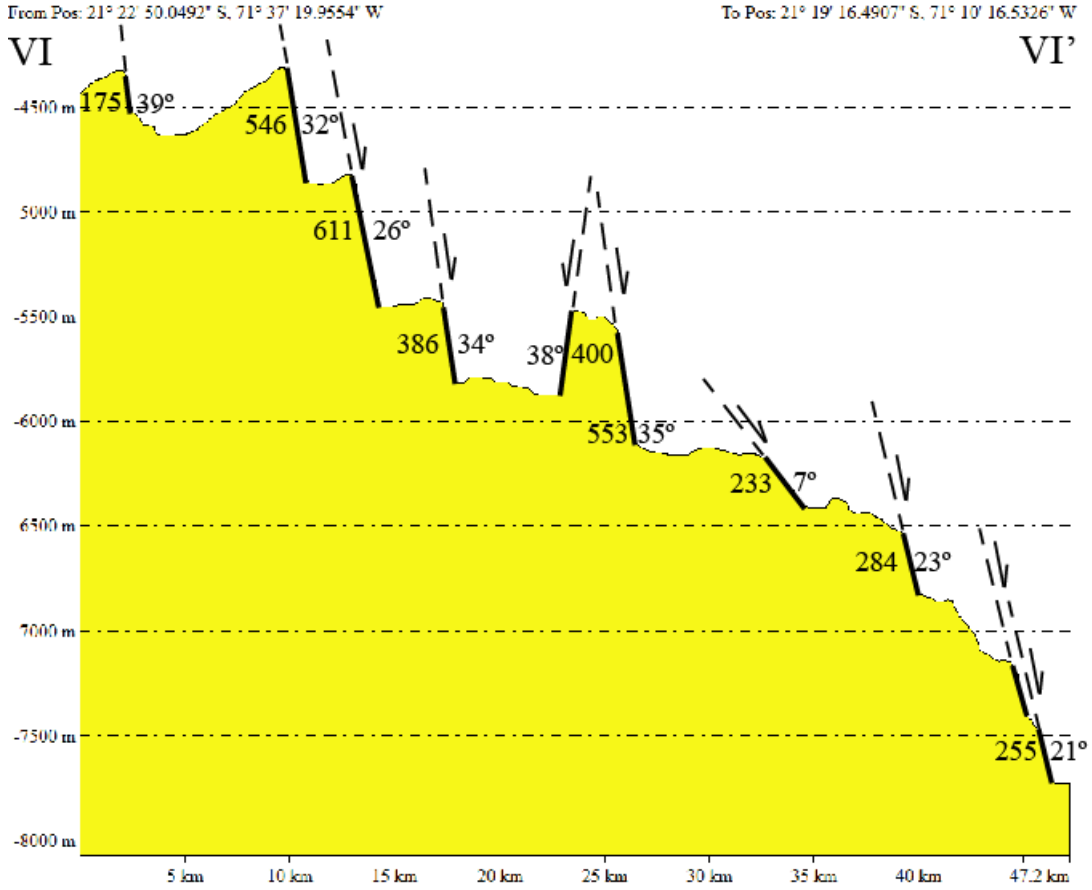
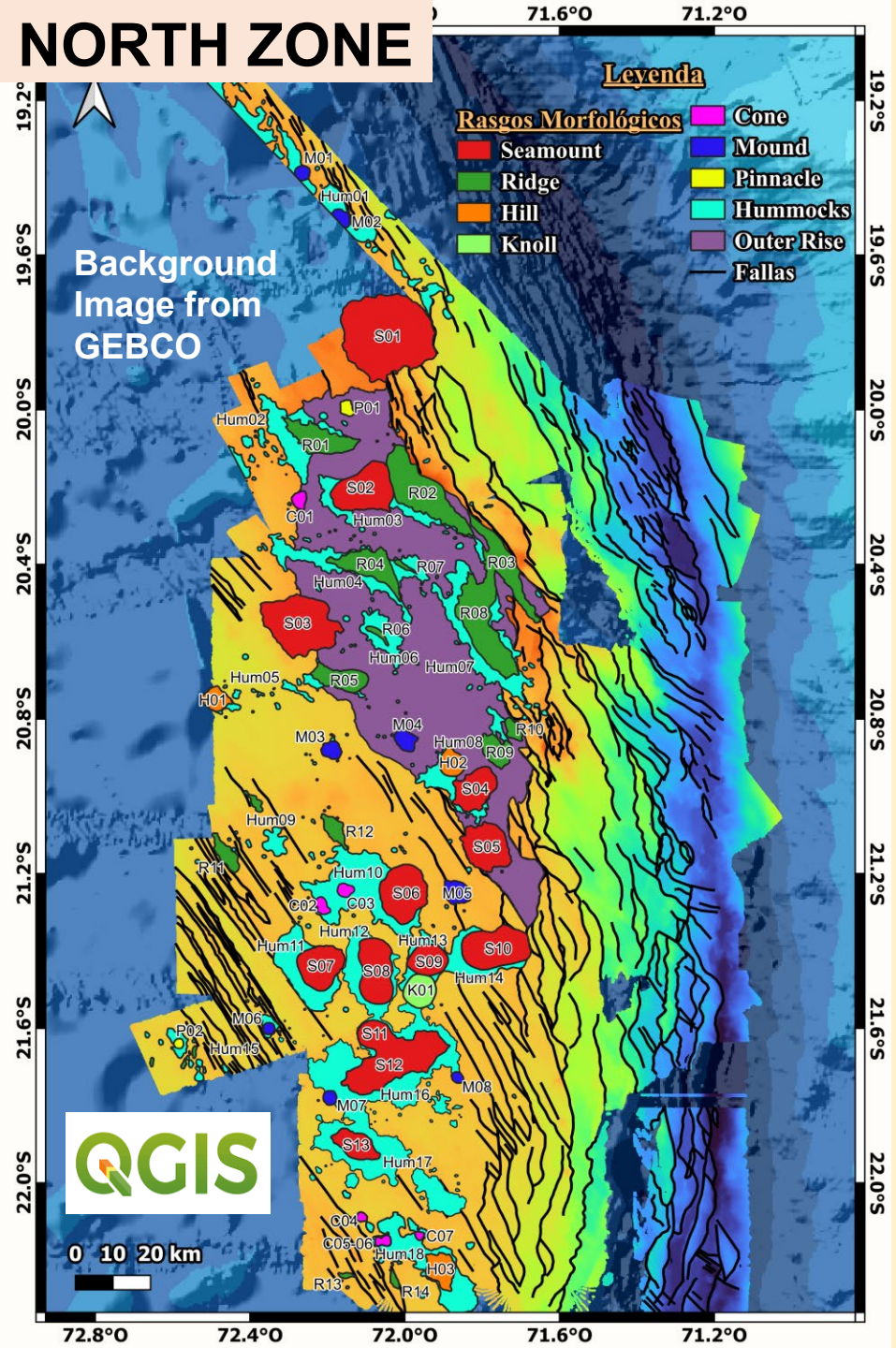
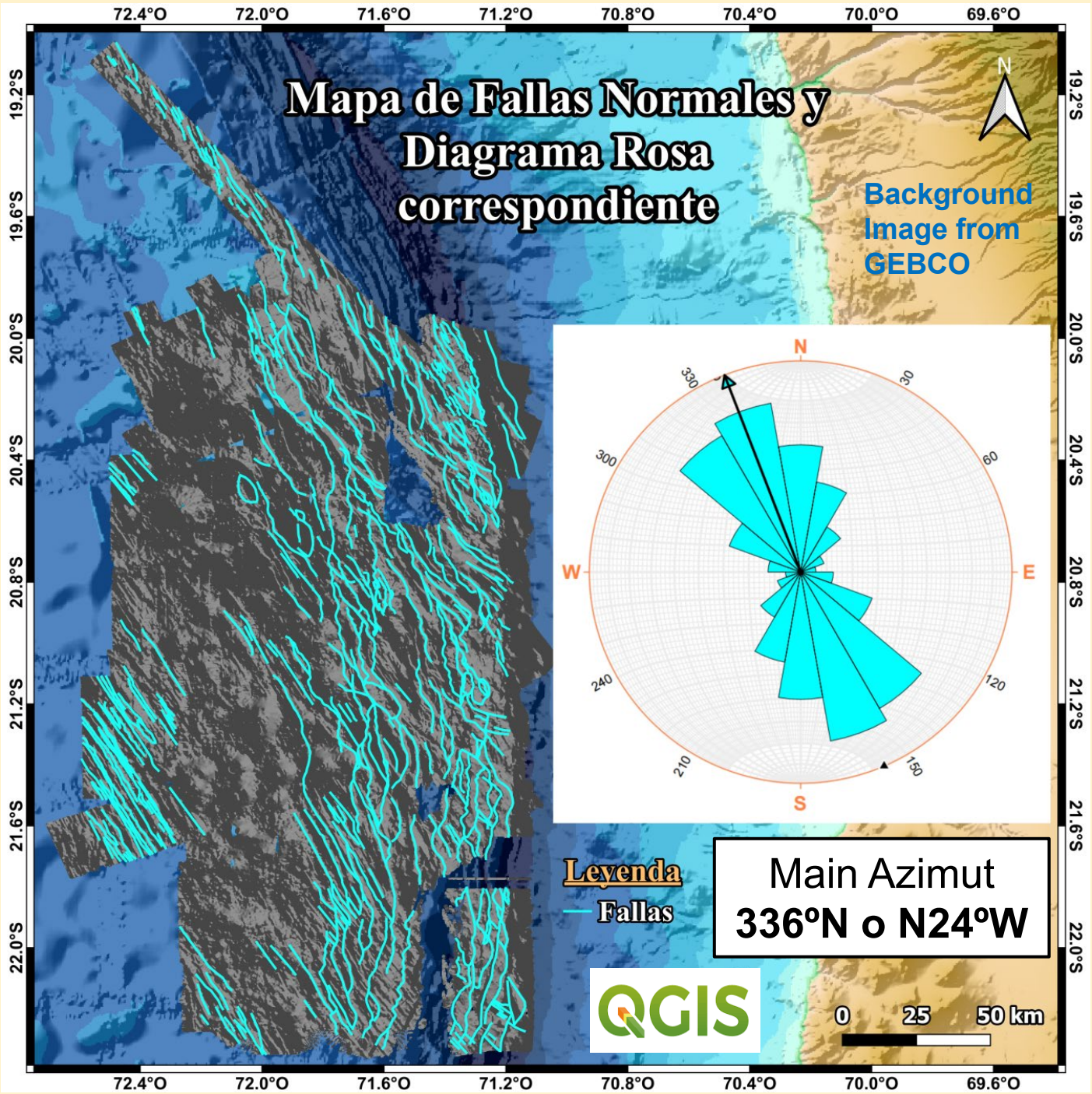


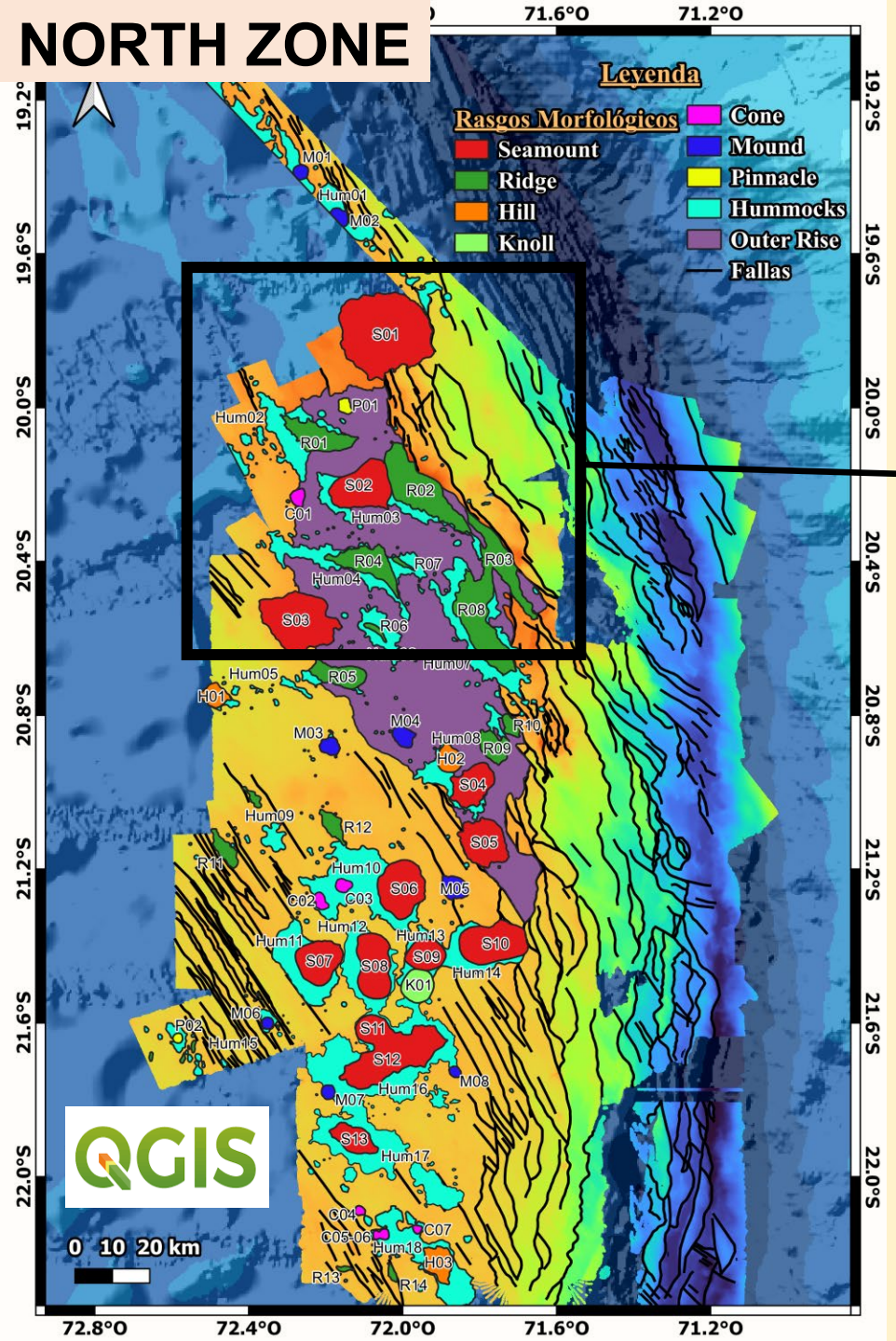


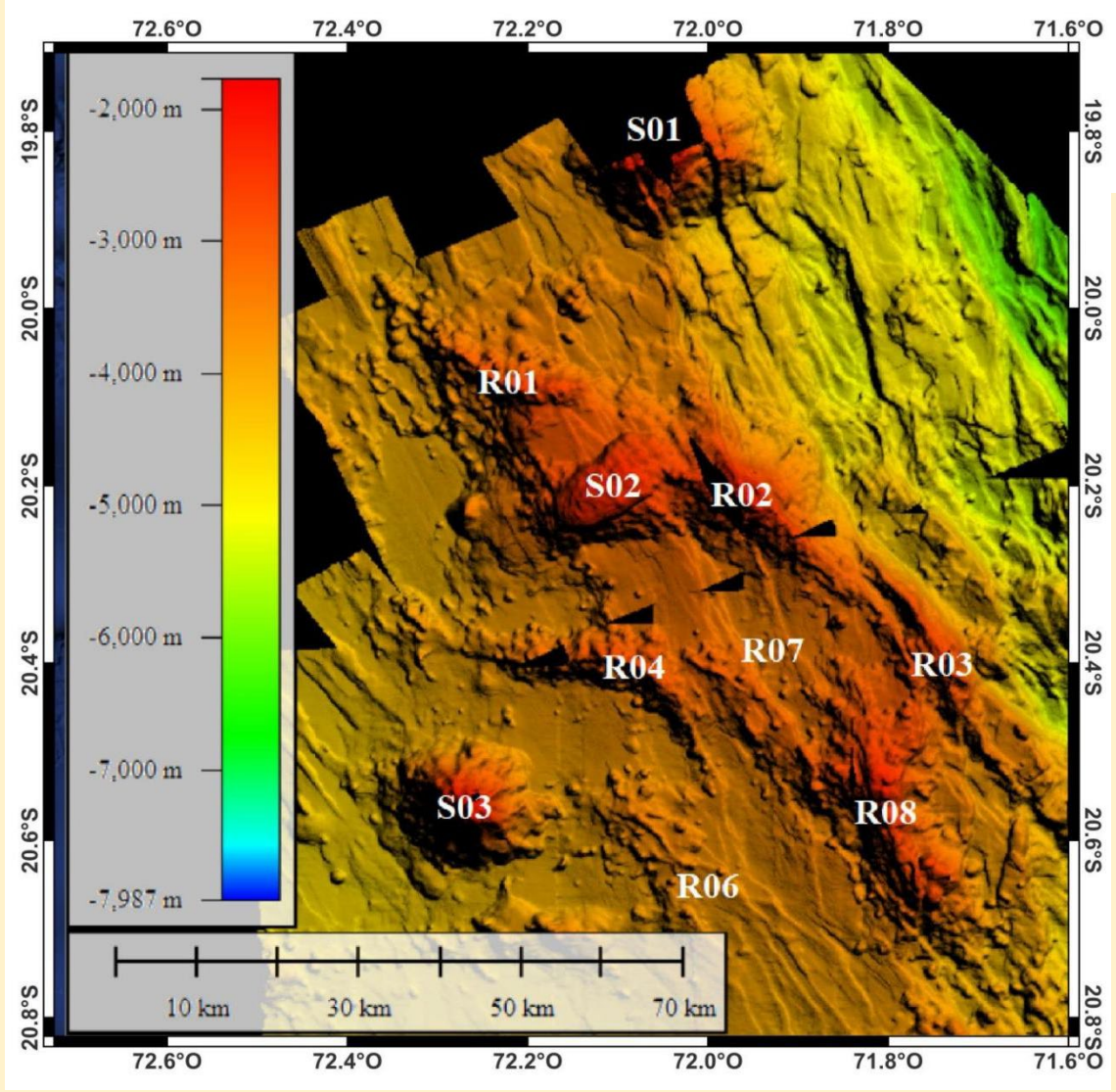
NORTH ZONE


Leyenda
Rasgos Morfológicos
Seamount
Ridge
Hill
Knoll
Cone
Mound
Pinnacle
Hummocks
Outer Rise
Fallas
Background Image from GEBCO
QGIS
0 10 20 km


Mapa de Fallas Normales y Diagrama Rosa correspondiente
Background Image from GEBCO
N
W
E
S
Leyenda
Fallas
Main Azimut
336°N o N24°W
QGIS
0 25 50 km

NORTH ZONE



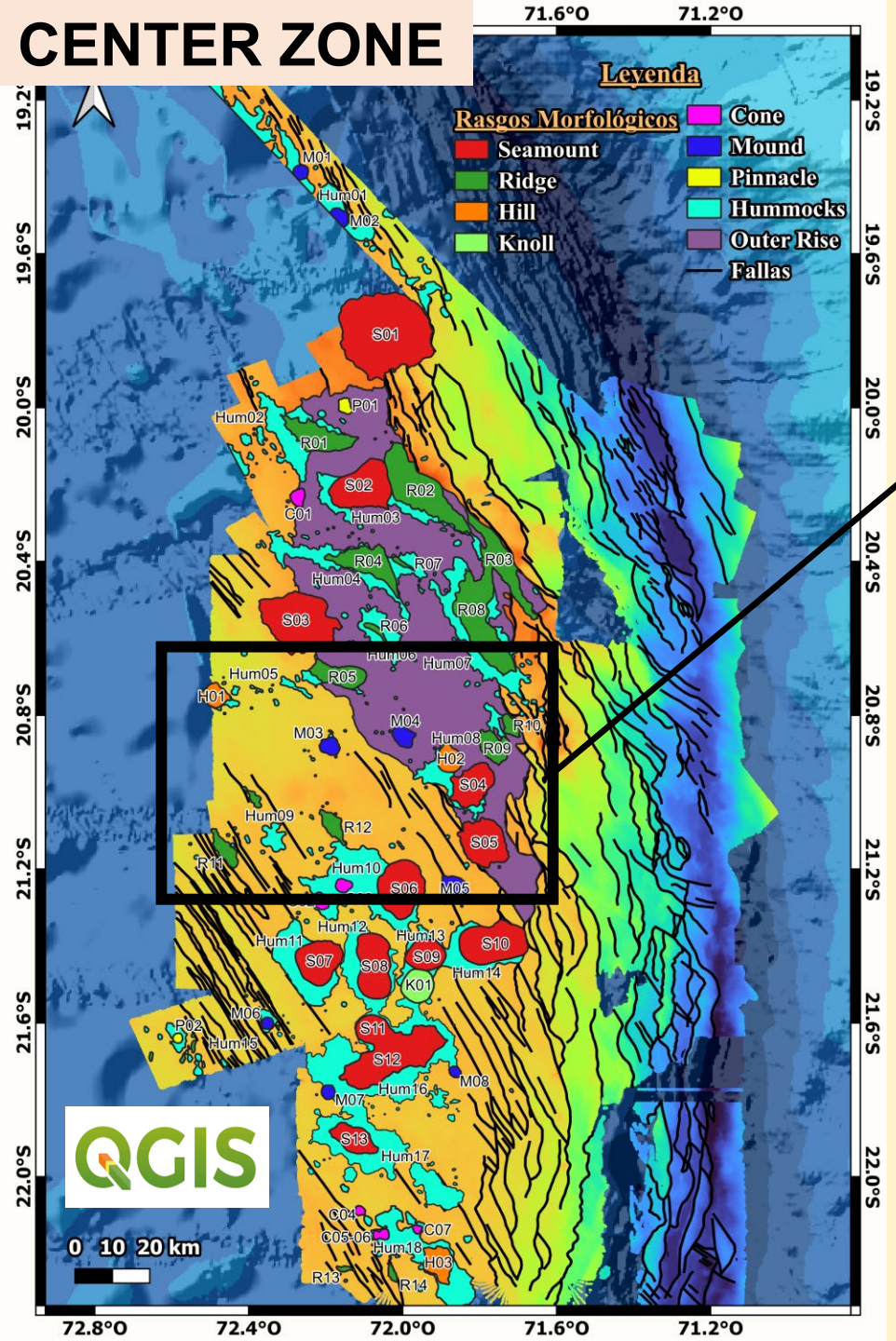


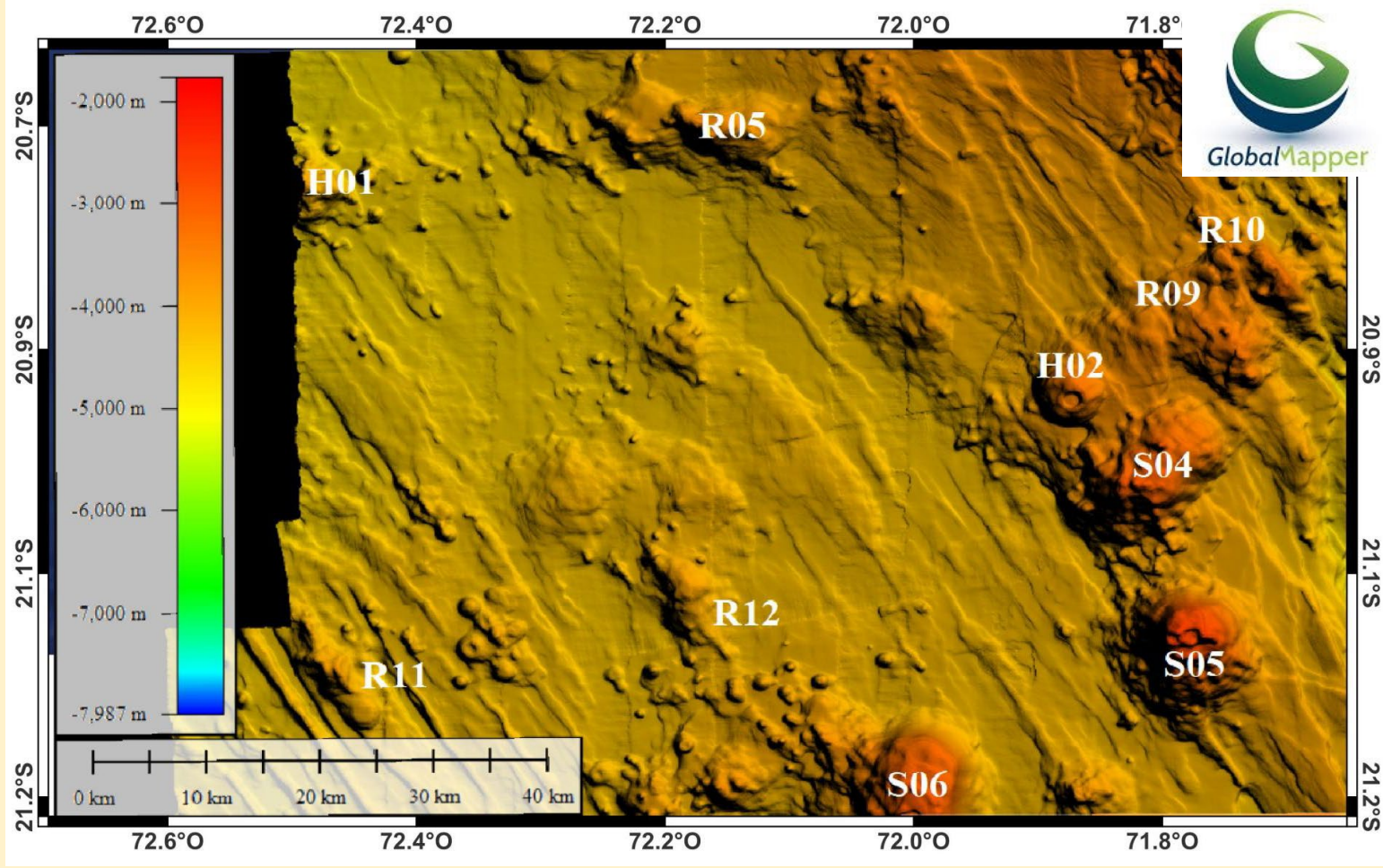
S01 (?) > **S03** (2.463 m) > **S02** (1.053 m)

R08 (1.349 m) > **R02** (1.100 m) > **R04** (956 m) > **R01** (943 m) > **R03** (844 m)

R06 (368 m) > **R07** (319 m)

CENTER ZONE





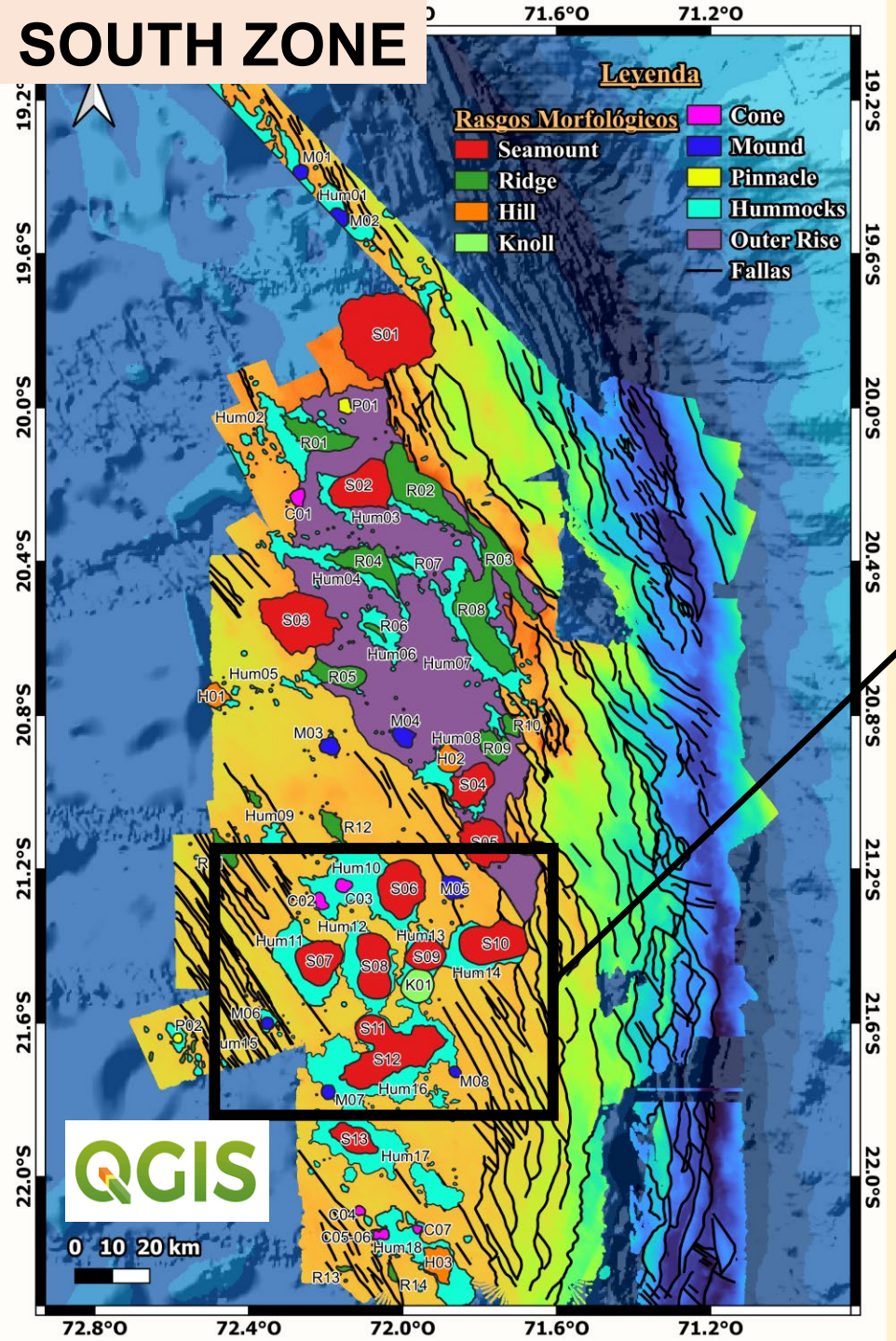
H02 (673 m) > **H01** (575 m)

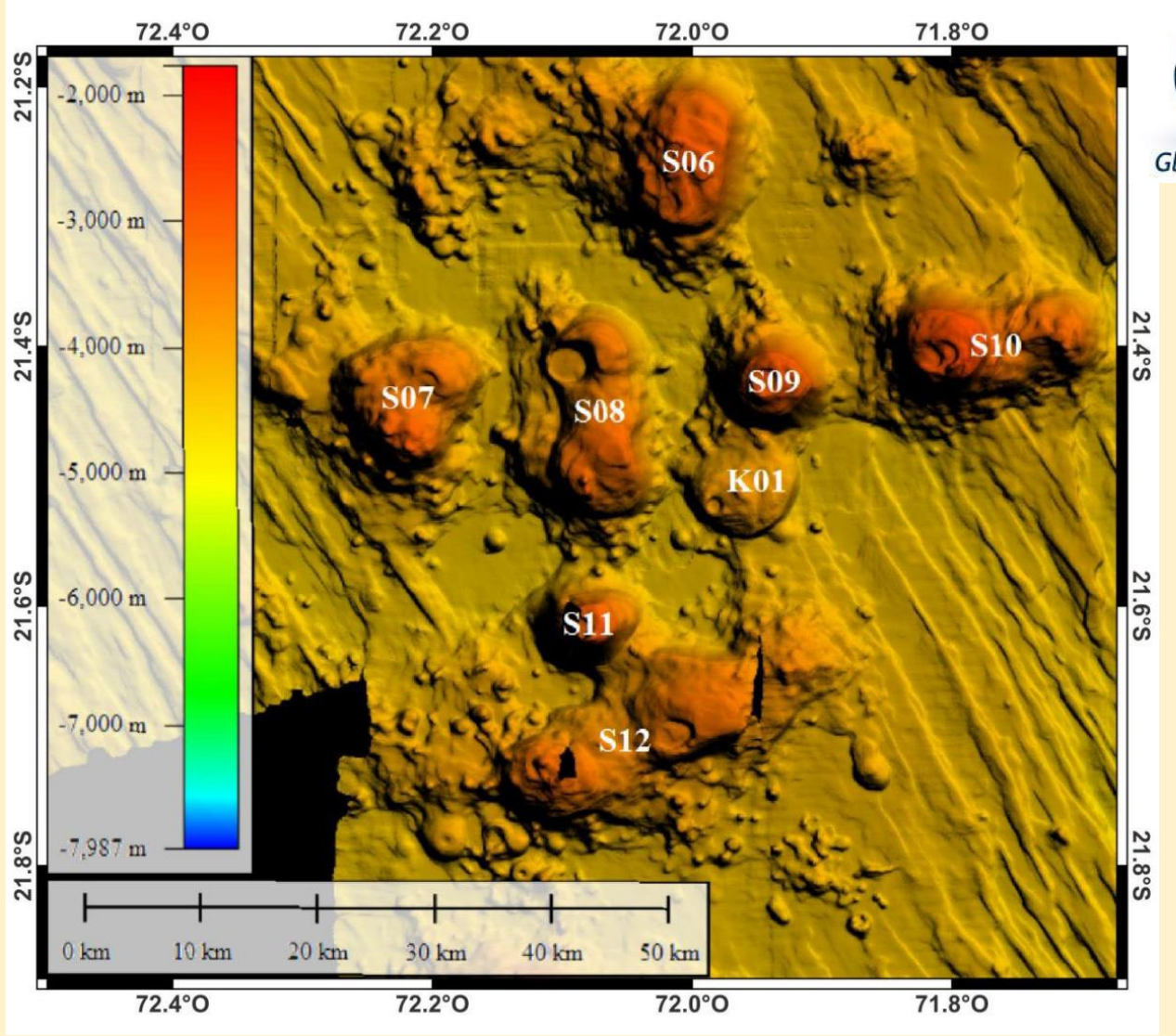
R05 (634 m) > **R10** (570 m) > **R11** (451 m) > **R12** (424 m) > **R09** (374 m)

R09 (374 m) **>** **R06** (368 m) > **R07** (319 m)

S05 (1.422 m) > **S04** (1.026 m)

SOUTH ZONE



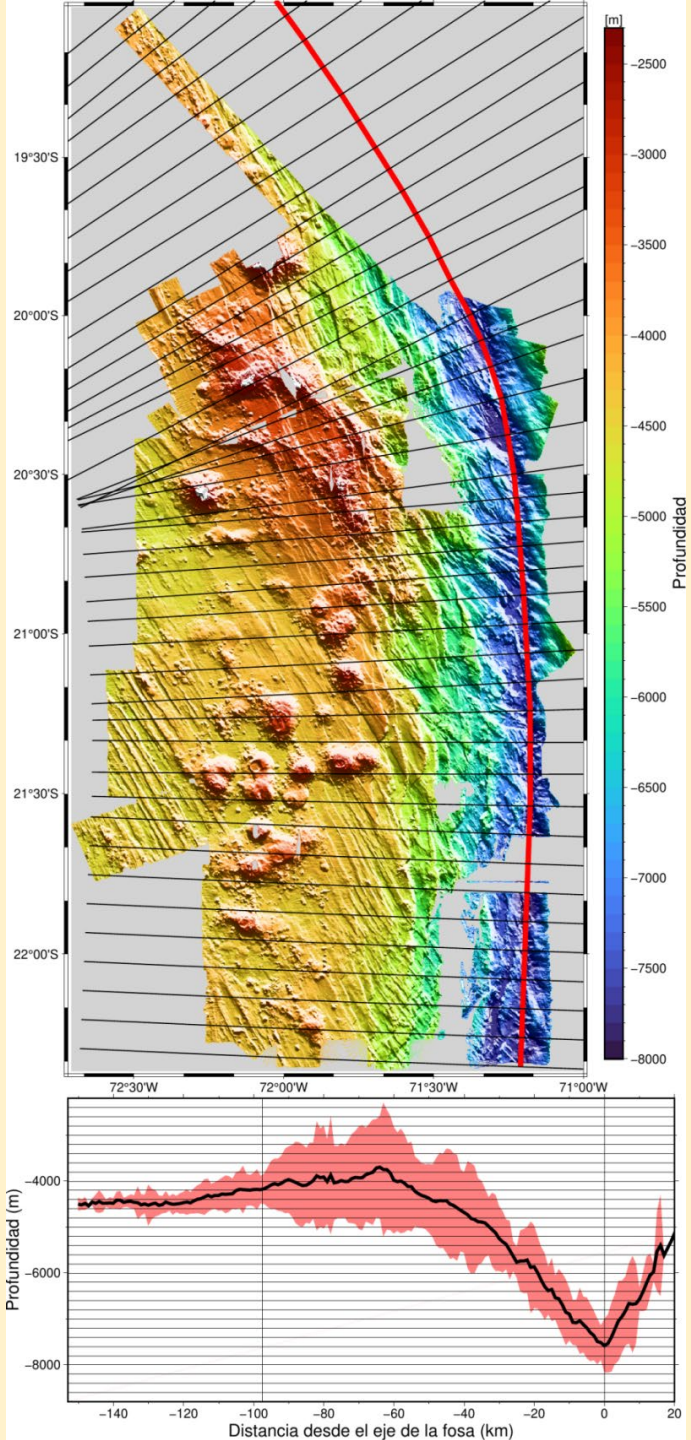


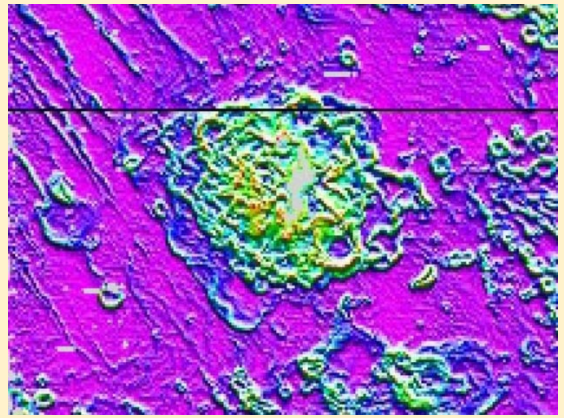
K01 (533 m)

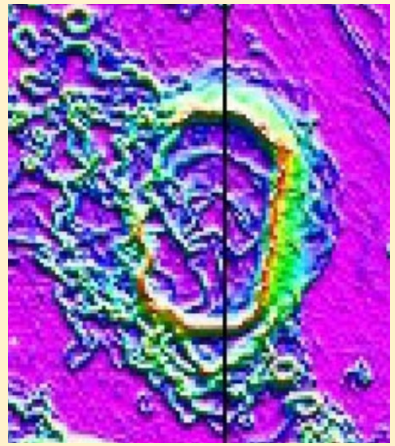
S10 (1.660 m) > **S11** (1.481 m) > **S09** (1.473 m) > **S07** (1.403 m) > **S08** (1.380 m) > **S06** (1.379 m) > **S12** (1.123 m)

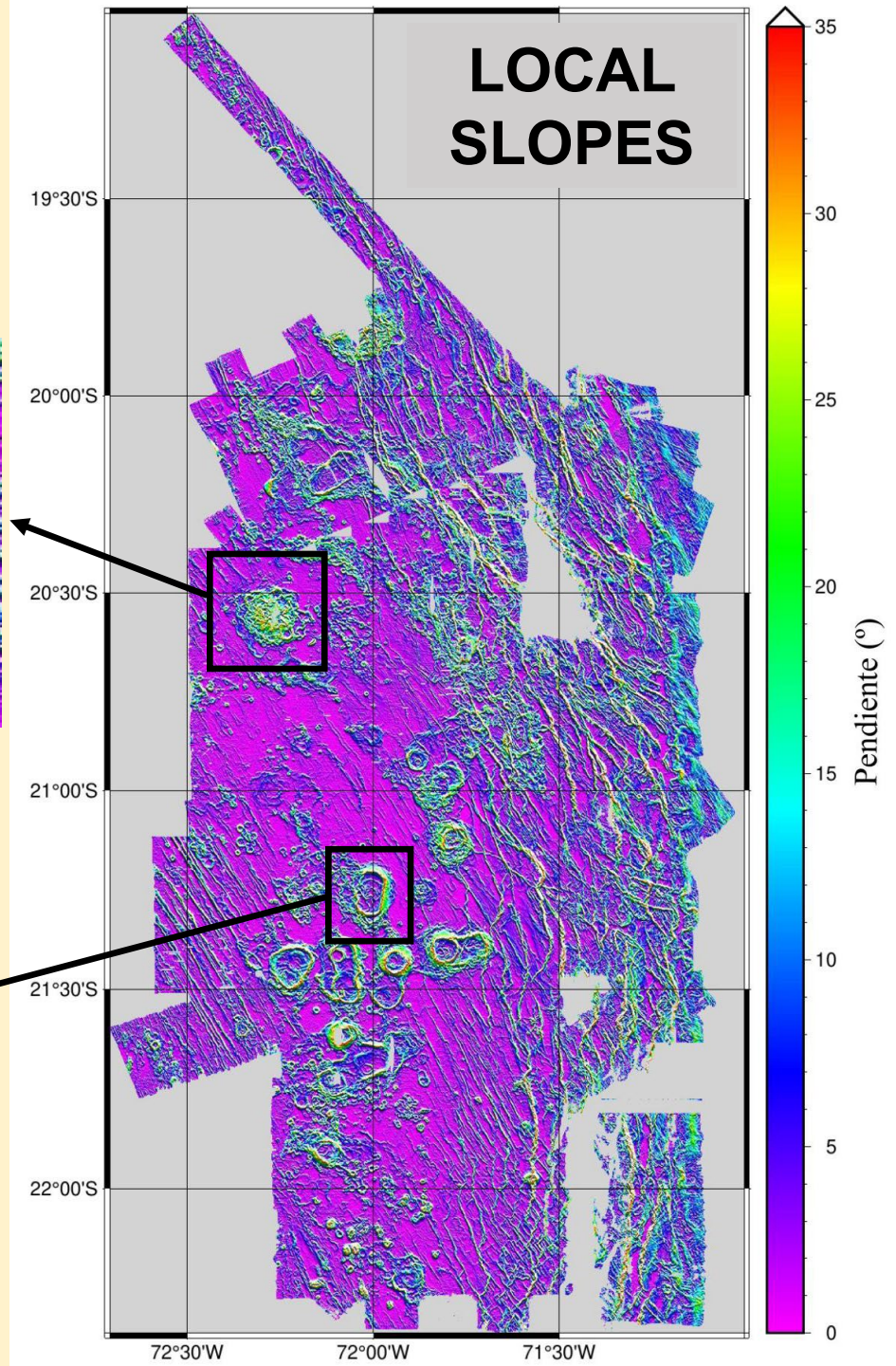
Results

OUTER RISE







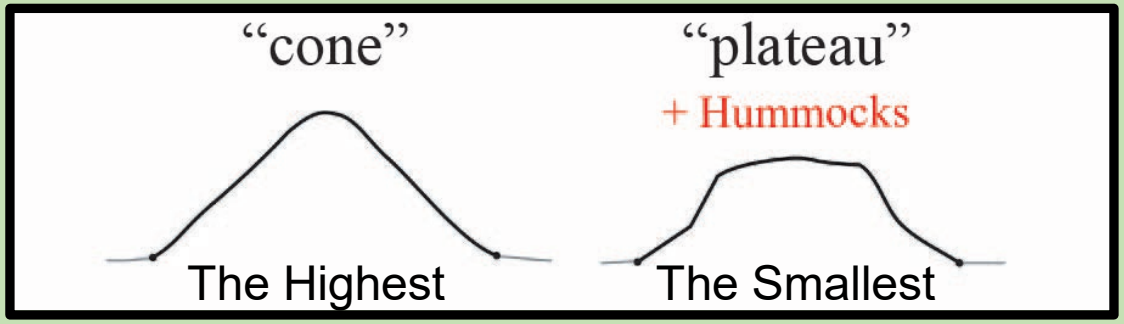


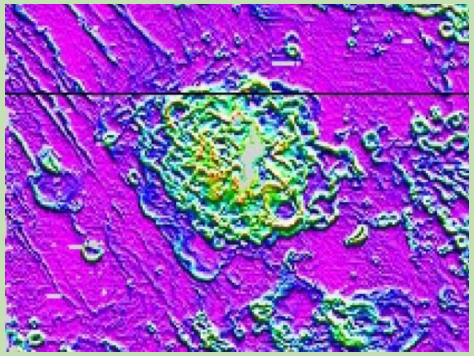
Discussions

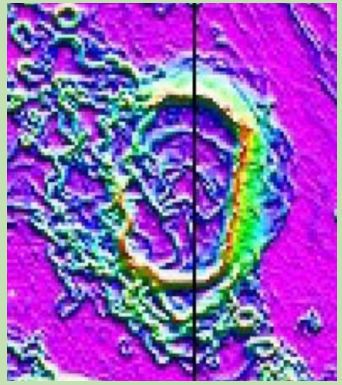
There are two different kinds of seamounts

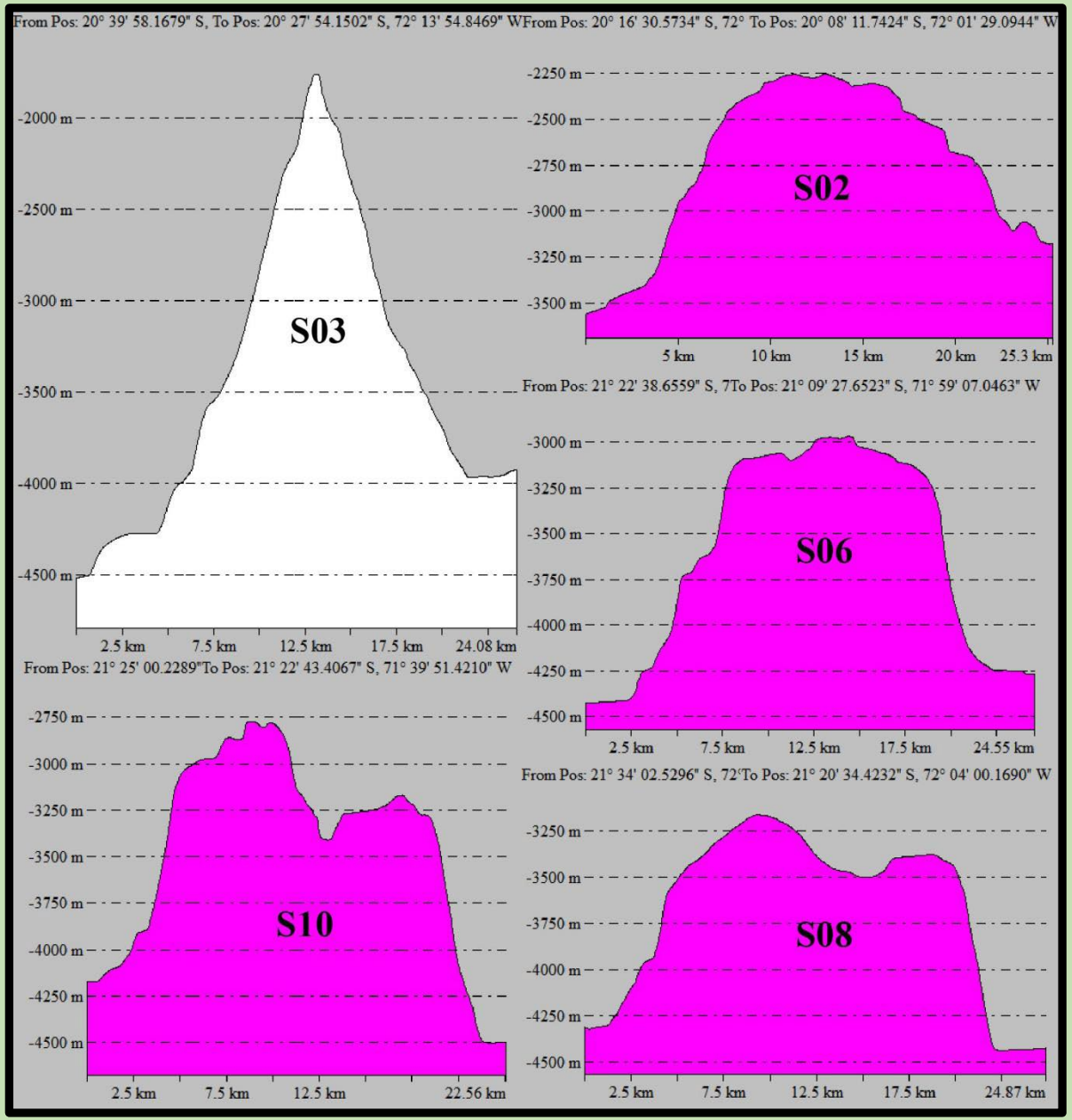
Group A

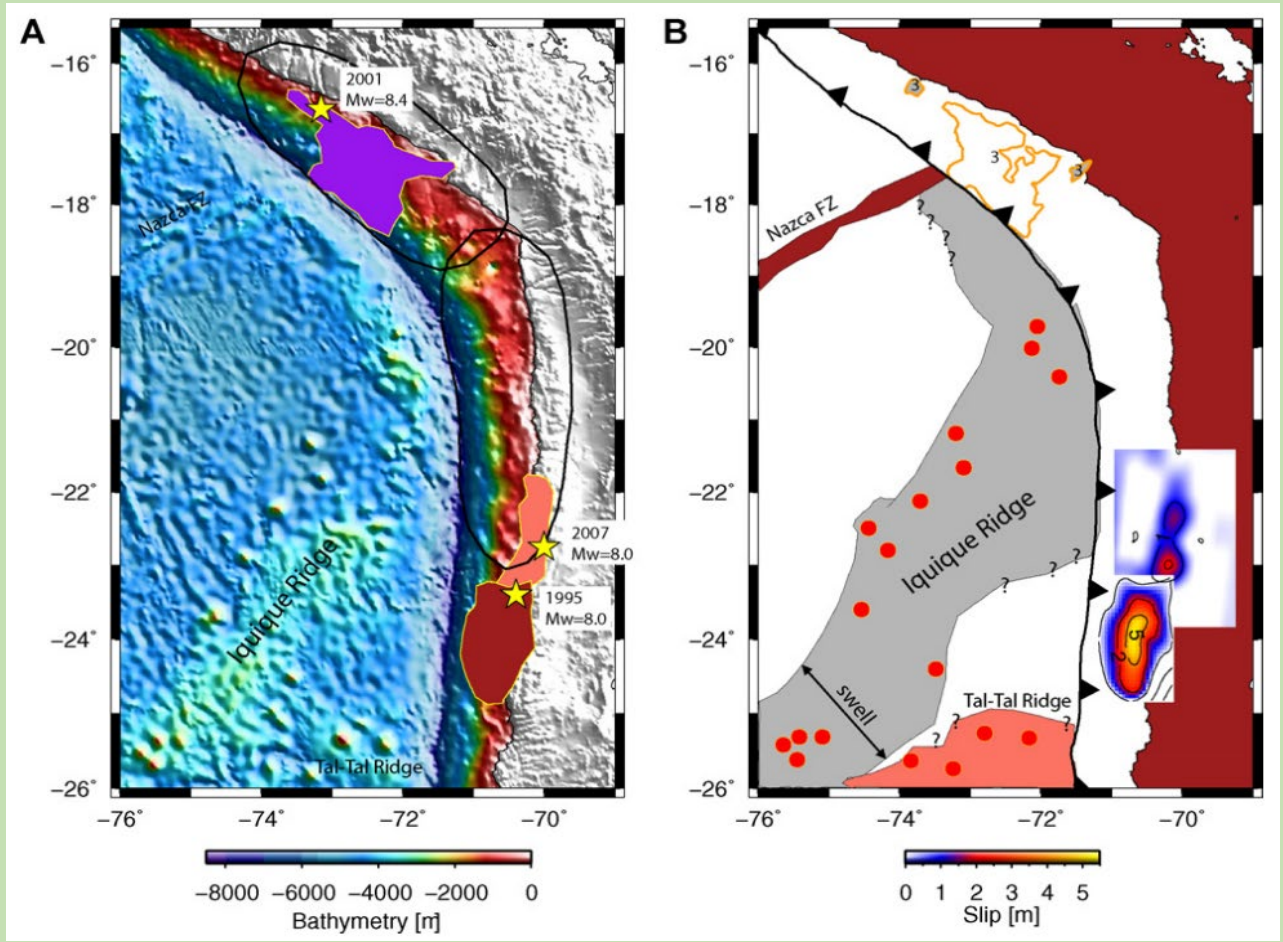
Group B



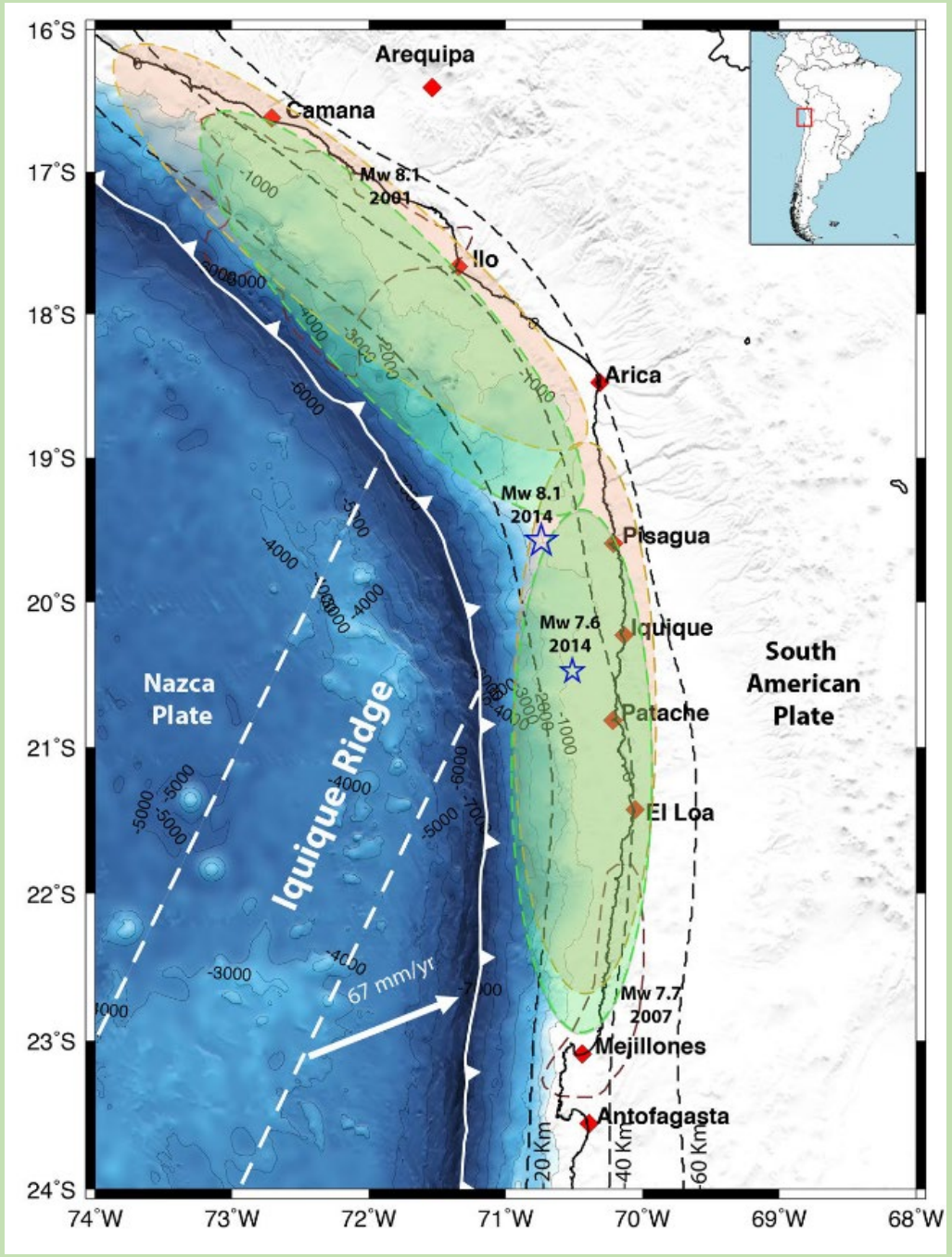






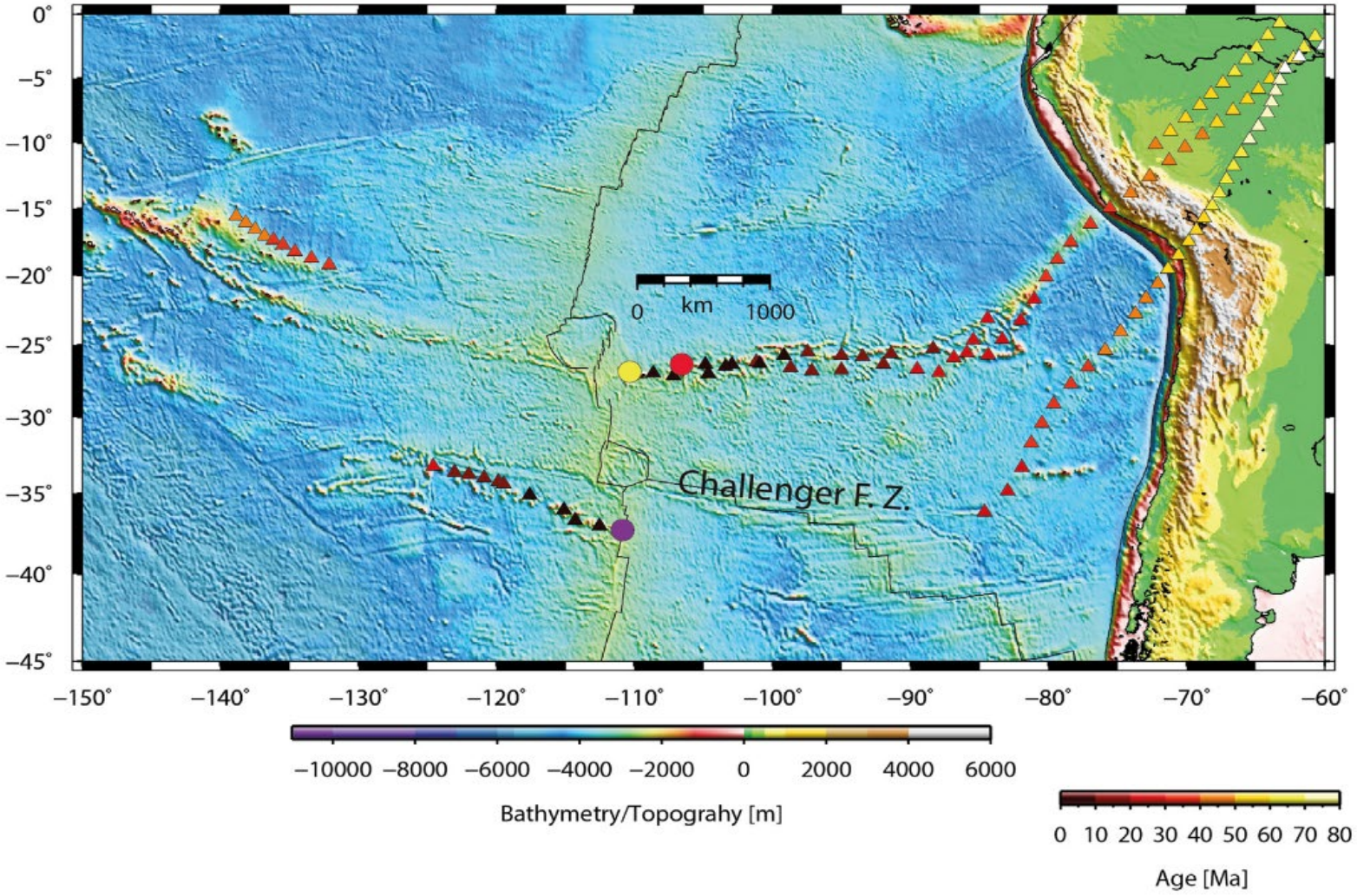


(Contreras-Reyes & Carrizo, 2011)



(Shrivastava *et al.*, 2019)

Origin of the Iquique Ridge?

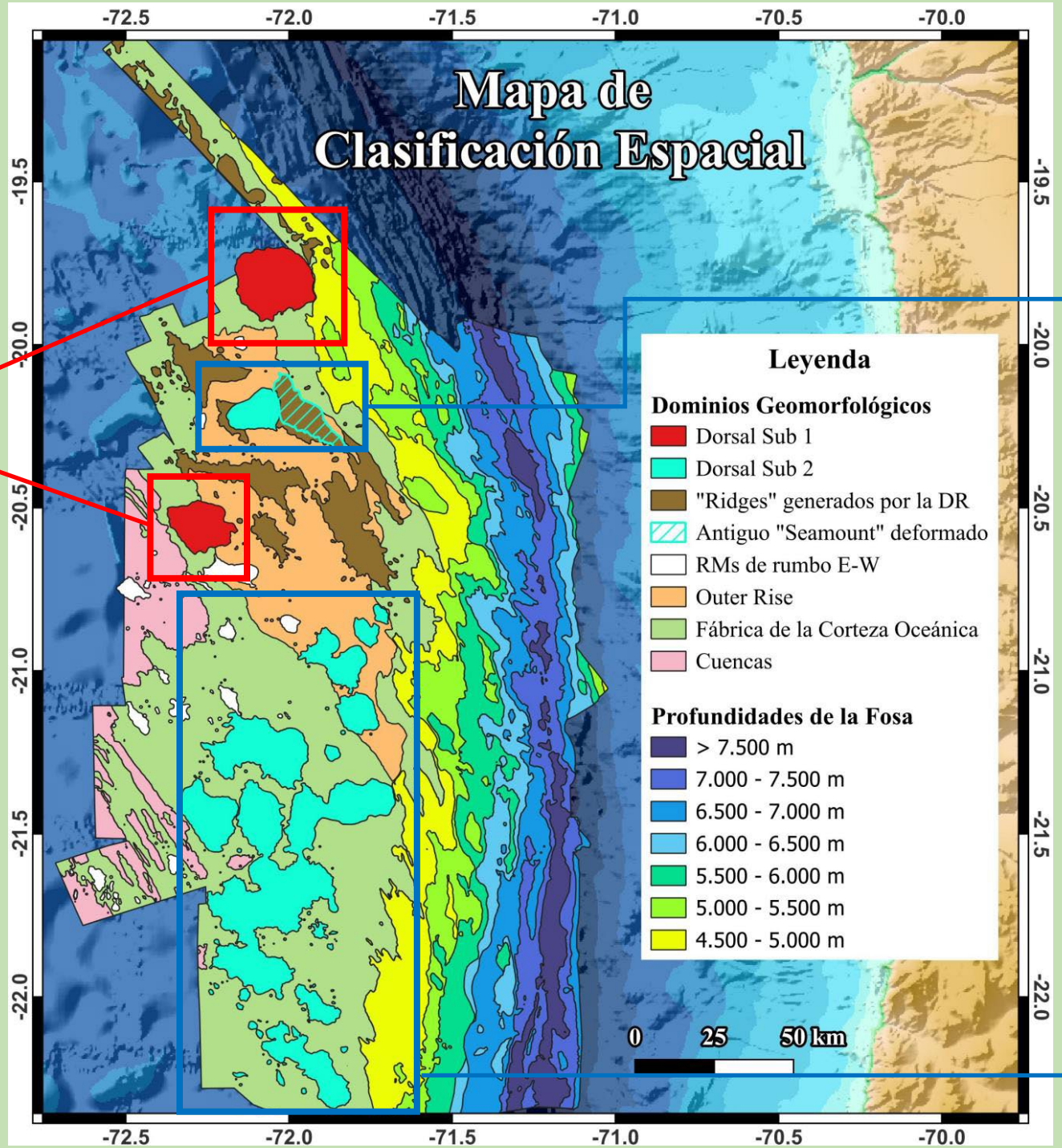


● : Eastern Hotspot/Easter Island Tuamotu Plateau (Pacific branch) and Easter Seamount Chain (Nazca branch)

● : Salas y Gómez Hotspot/Easter Seamount Chain and Nazca Ridge **(Bello-González *et al.*, 2018)**

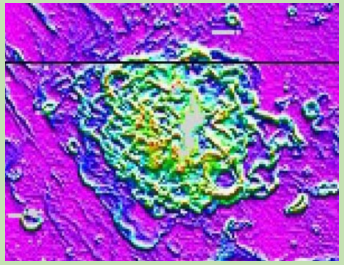
● : Foundation Hotspot/Foundation Chain (Pacific branch) and Iquique Ridge (Nazca branch)

Geomorphological Domains



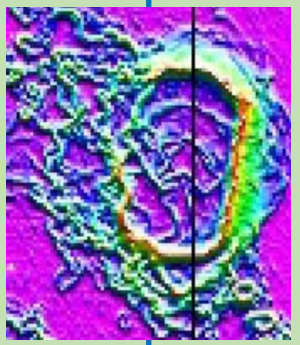
"cone"

TheHighest

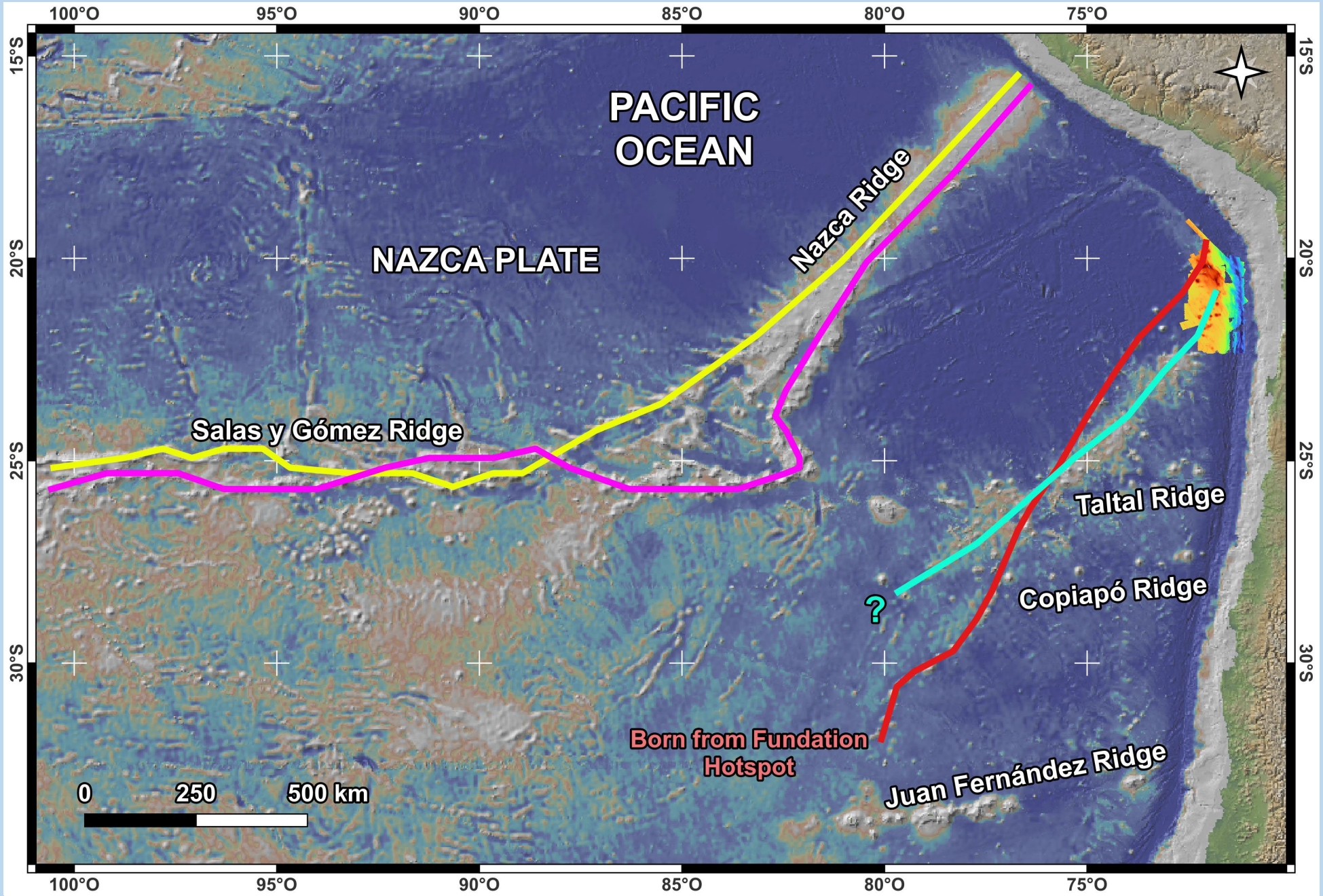


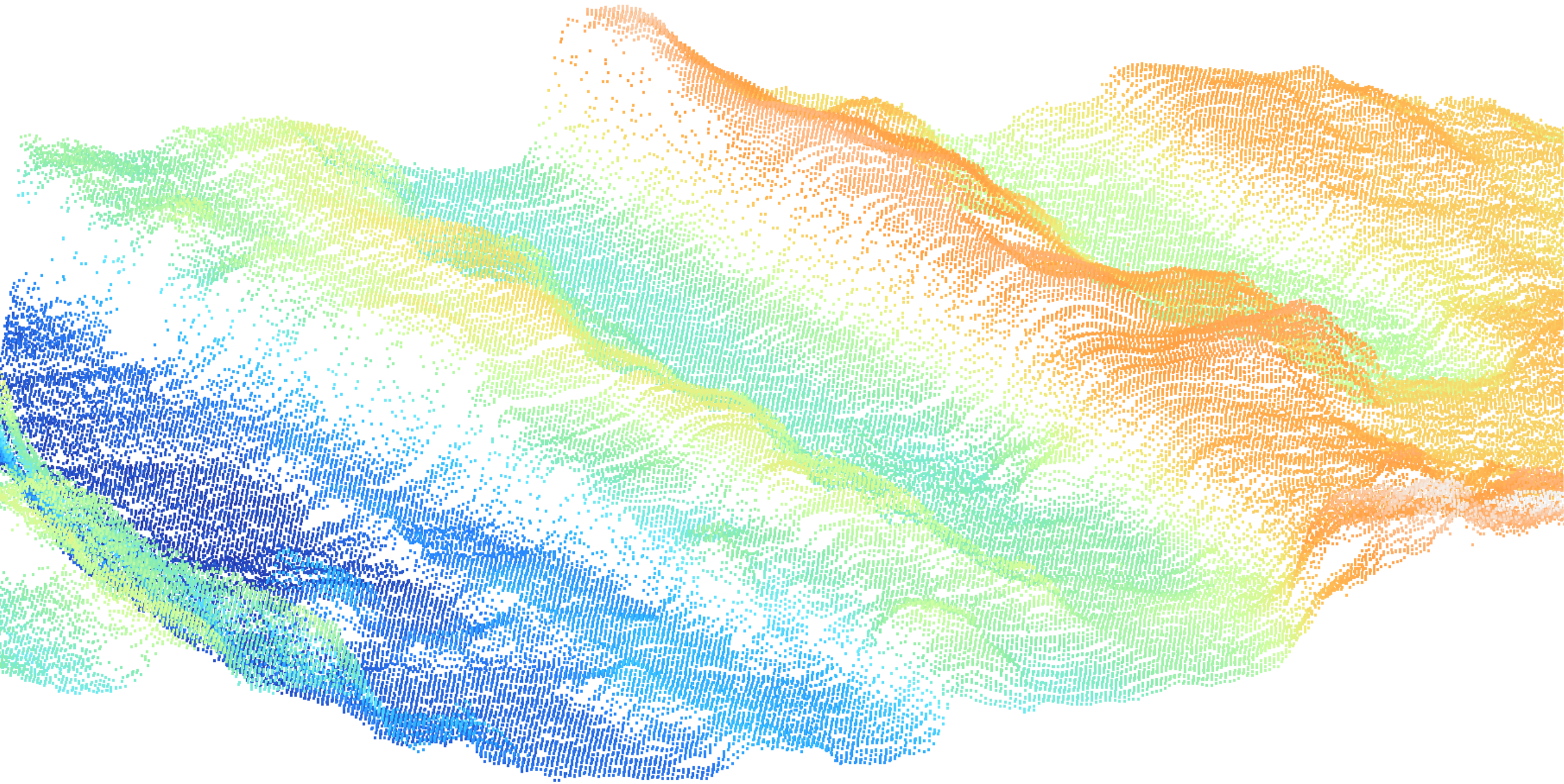
"plateau"
+ Hummocks

The Smallest



So what happend?

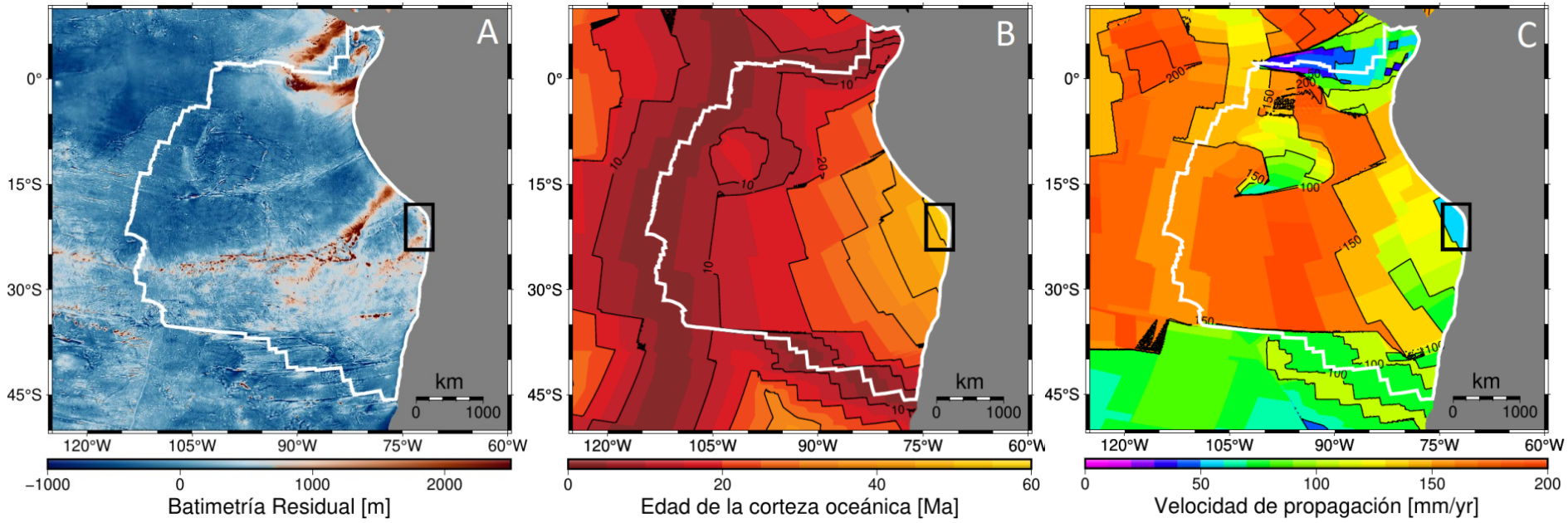




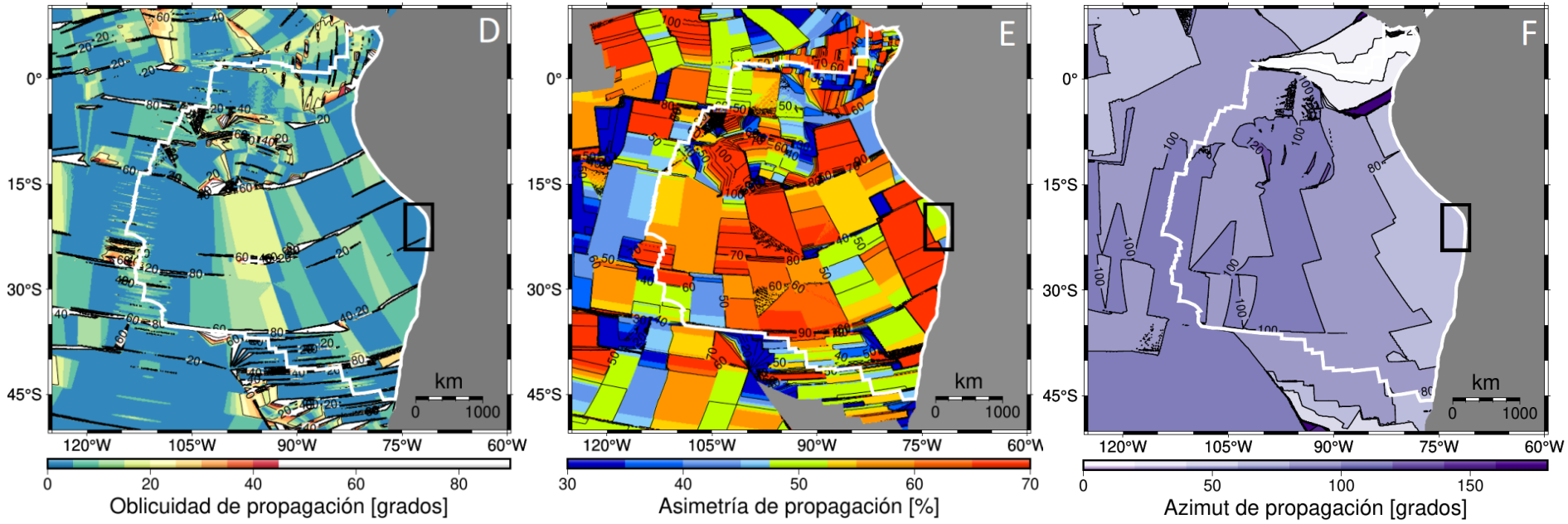
THANK YOU VERY MUCH FOR YOUR ATTENTION

ANNEXES

Nazca Plate



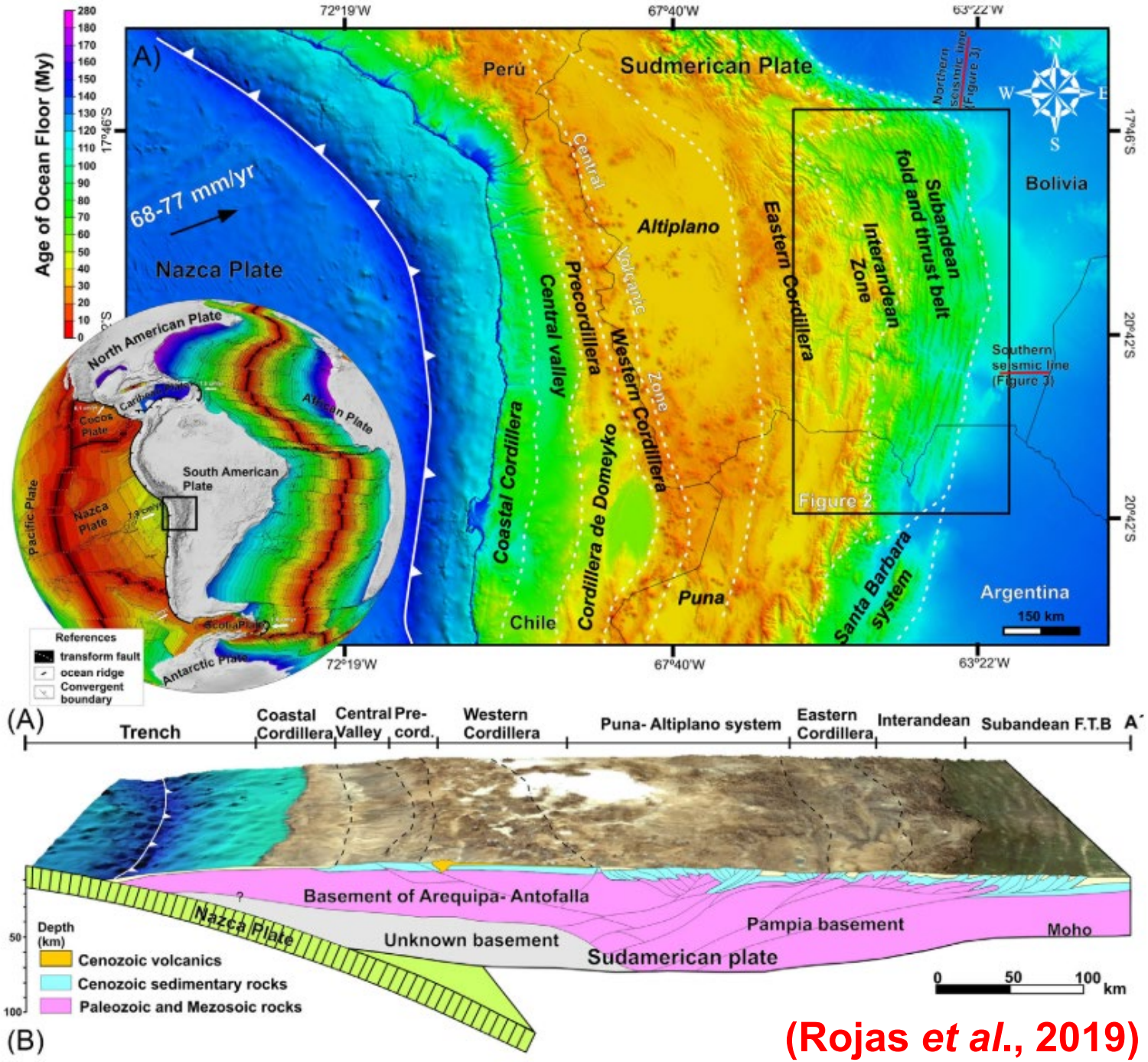
Map (A): [earthdynamics.org].



- It originated in the late Oligocene - early Miocene (23 Ma).
- 50 - 54 Ma old.
- 151 - 162 mm/year in the EPR.
- Subduction at a rate of 66 mm/year.
- Low obliquity angle (< 5º).
- Azimut of propagation N76ºE in almost the entire length of Chile.
- Subduction with a constant angle 20º approx. from 20 km depth.

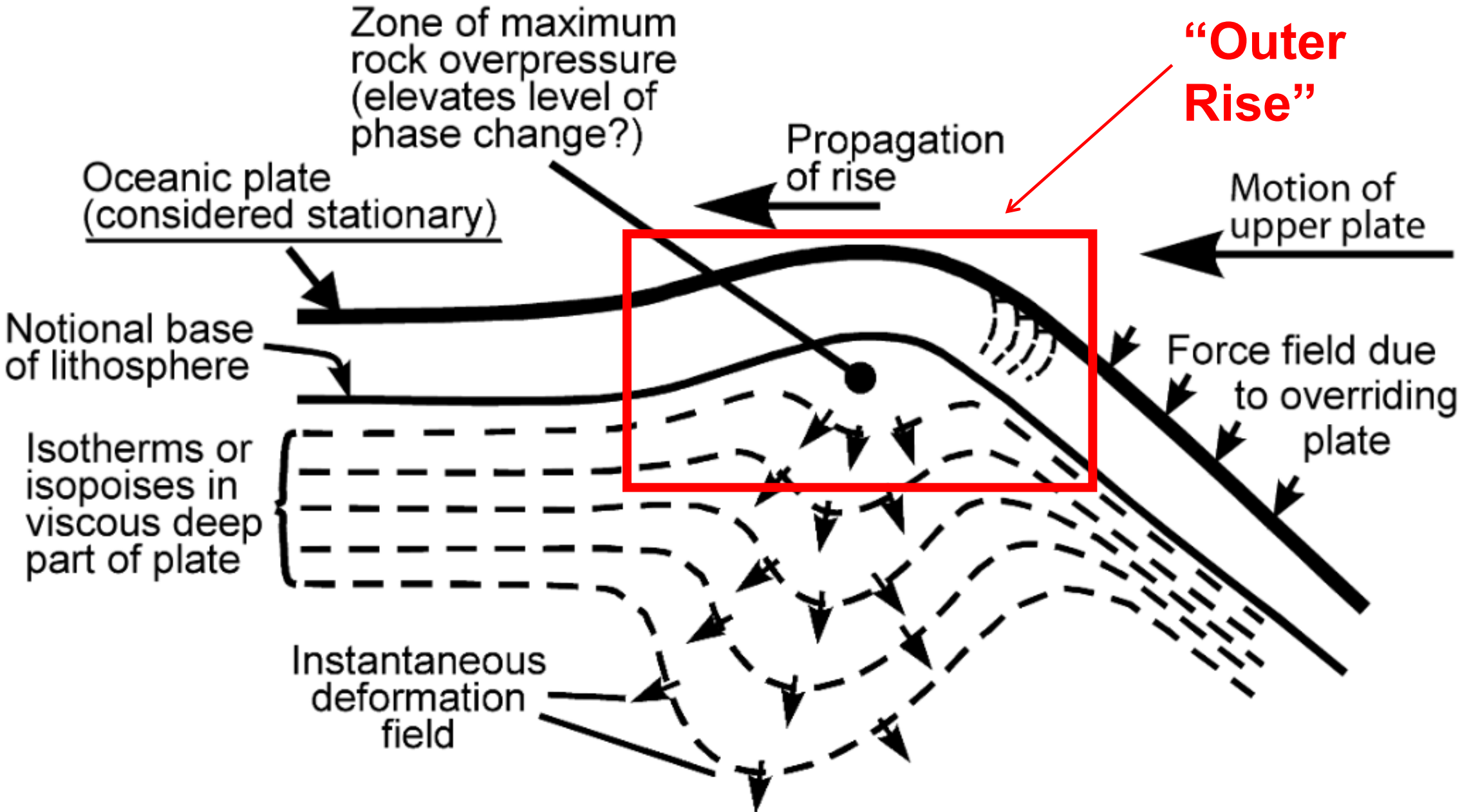
The maps from letter (B) to (F) were created based on data from Seton et al. (2020).

Codo de Arica



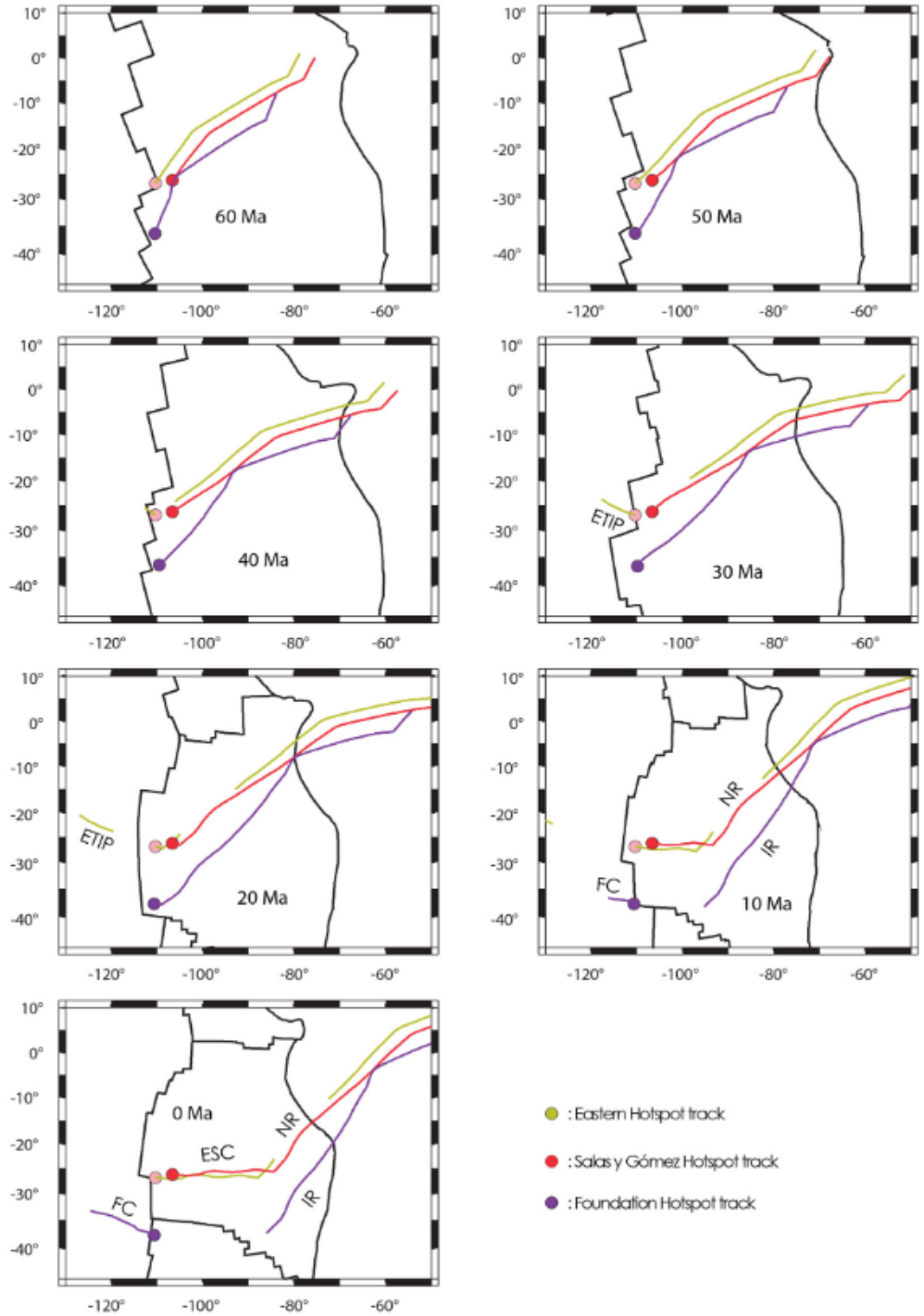
(Rojas *et al.*, 2019)

- El Oroclino Boliviano o también conocido como el Codo de Arica
- Deformación de los Andes Centrales
- Se caracteriza por la exageración de su curvatura
- Deformación progresiva de Oeste a Este
- Oligoceno Medio - Superior (28-23 Ma)



(Osmaston, 2008)

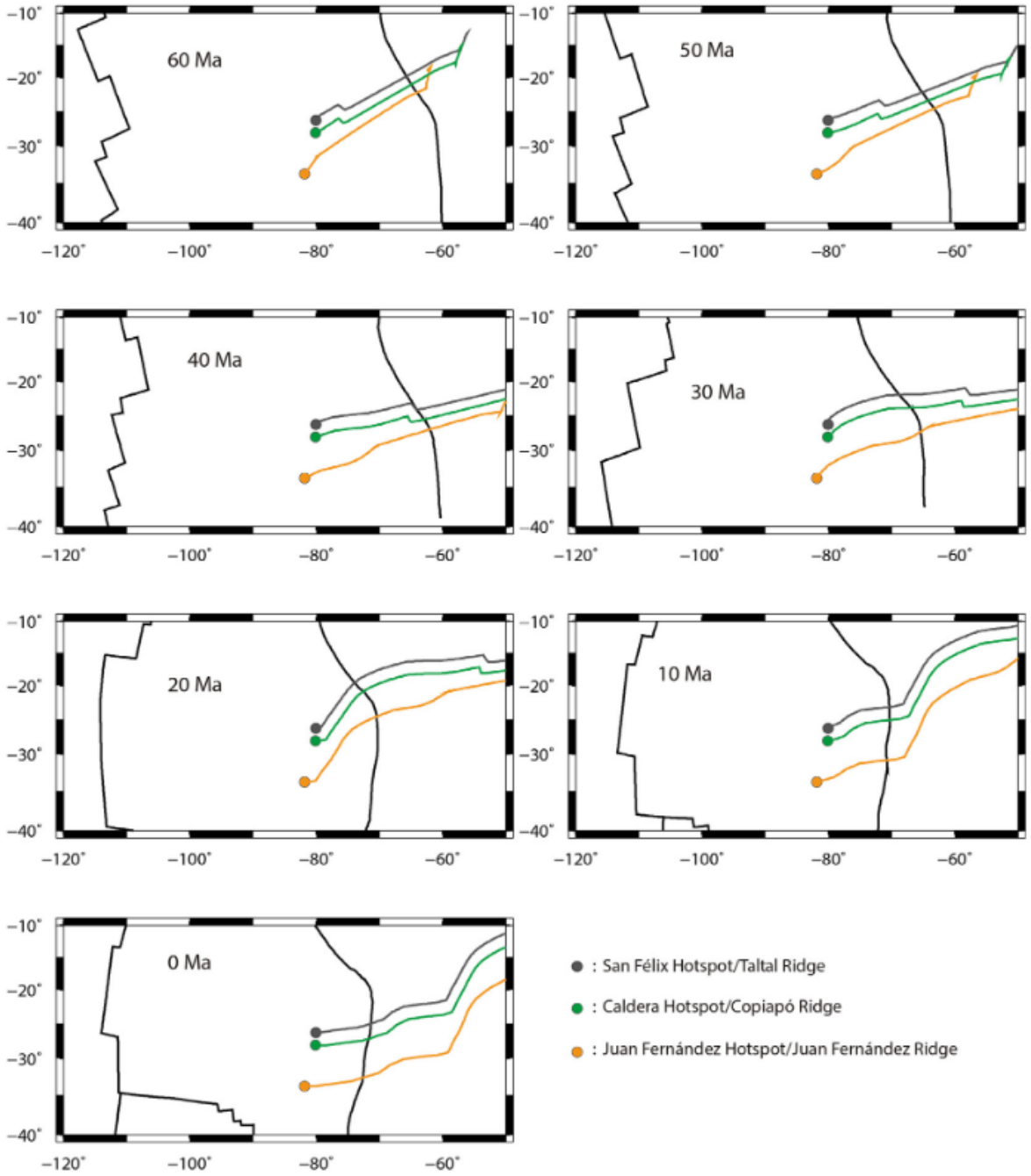
Reconstrucción de la trayectoria de los ridges de la placa de Nazca



- Eastern Hotspot track
- Salas y Gómez Hotspot track
- Foundation Hotspot track

(Bello-González *et al.*, 2018)

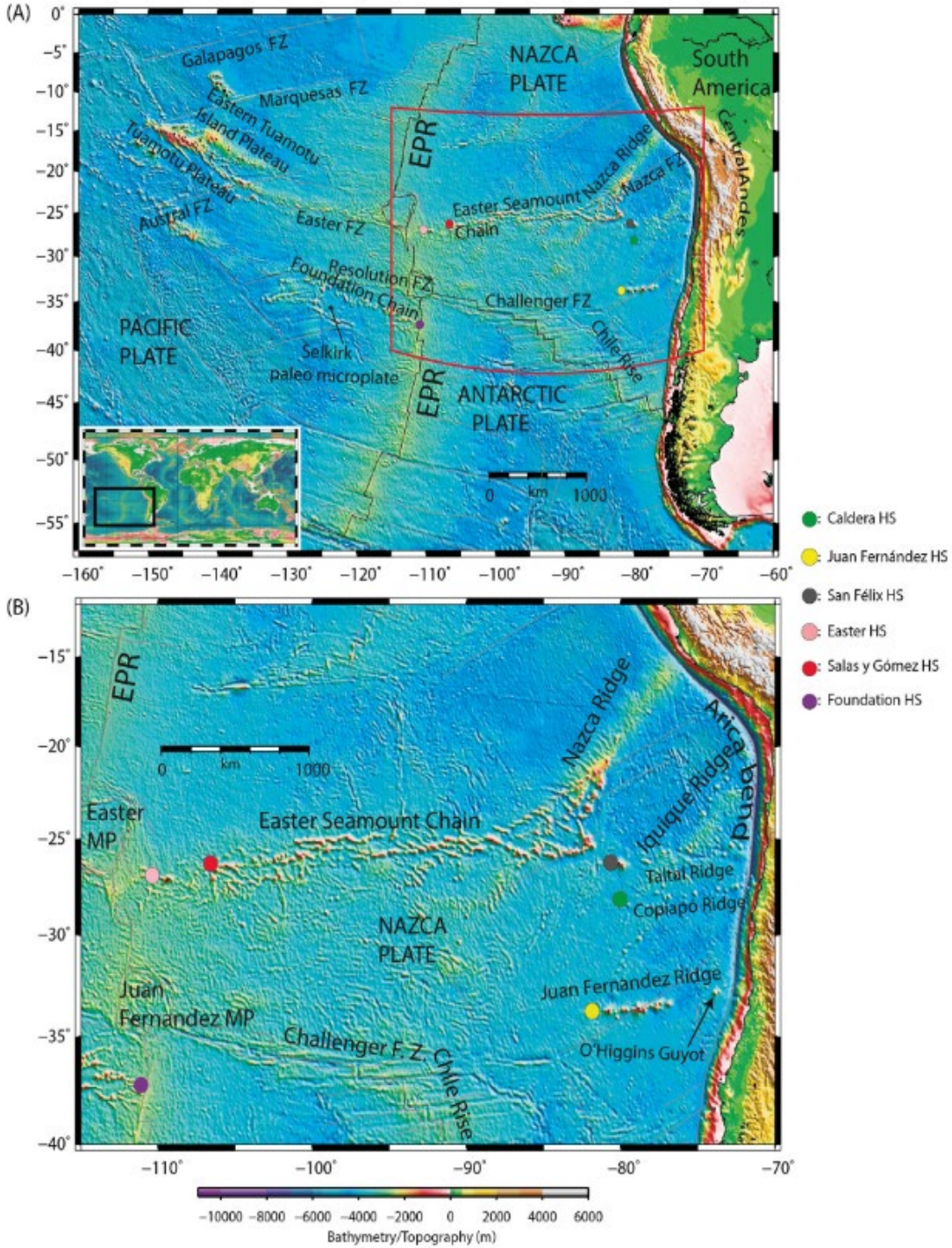
Reconstrucción de la trayectoria de los ridges de la placa de Nazca



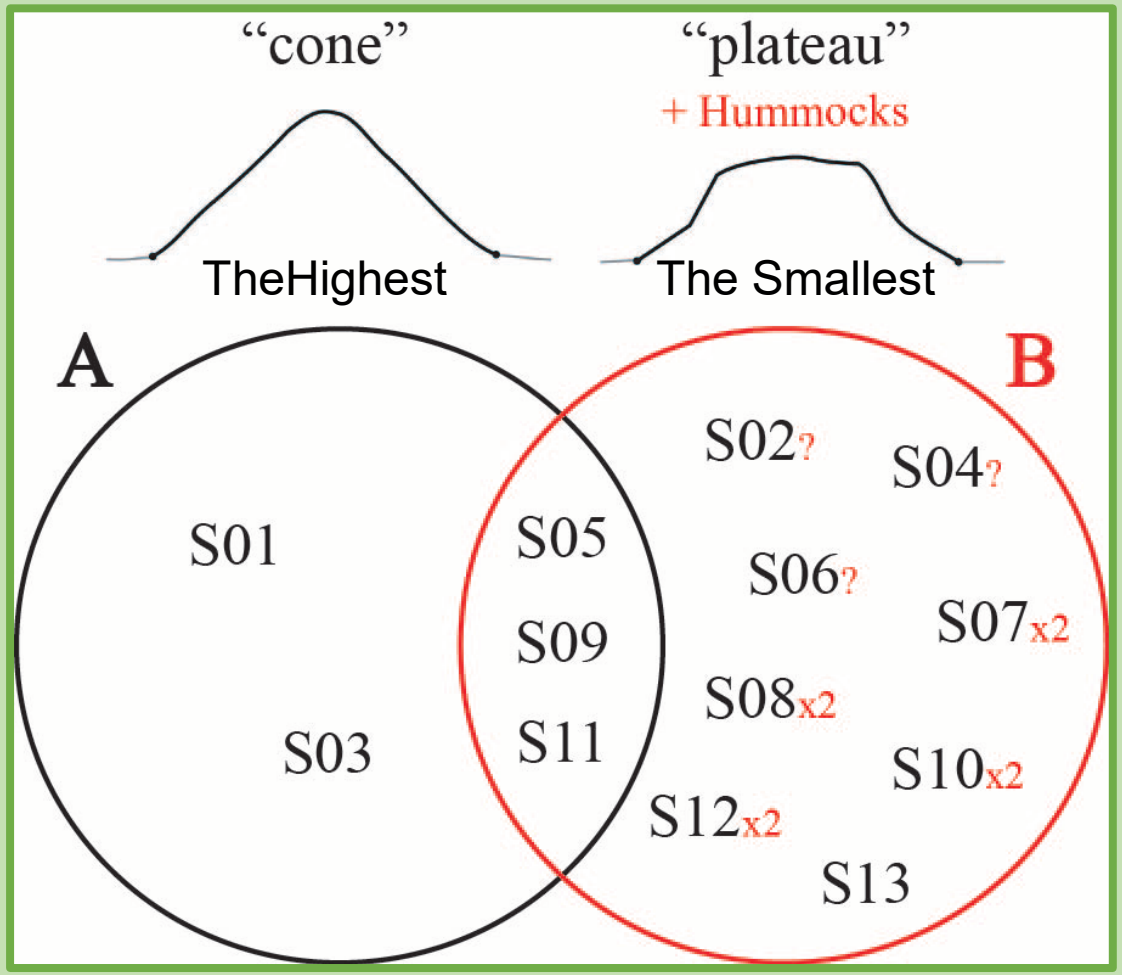
- San Félix Hotspot/Taltal Ridge
- Caldera Hotspot/Copiapó Ridge
- Juan Fernández Hotspot/Juan Fernández Ridge

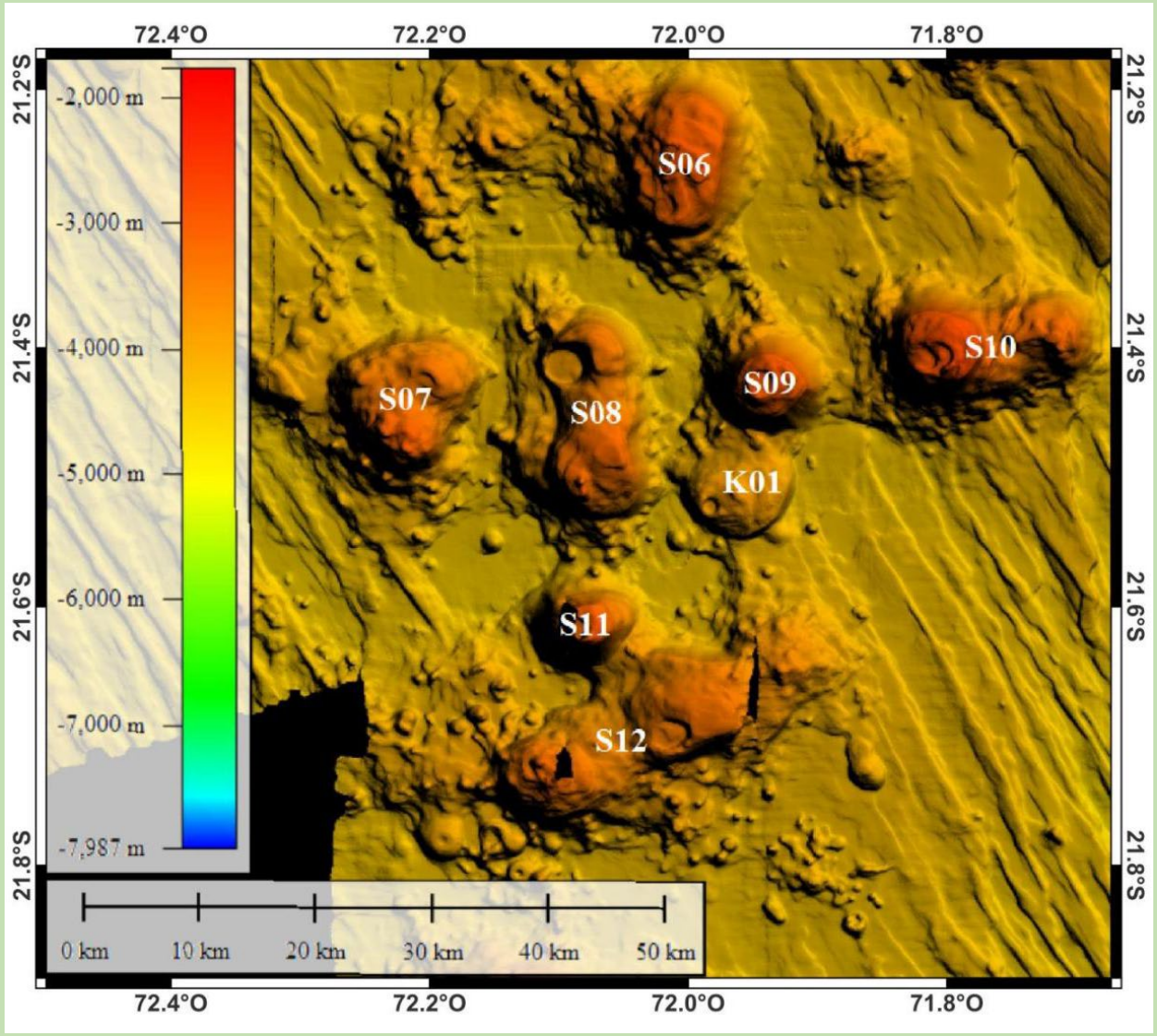
(Bello-González *et al.*, 2018)

Hot spots de la placa de Nazca



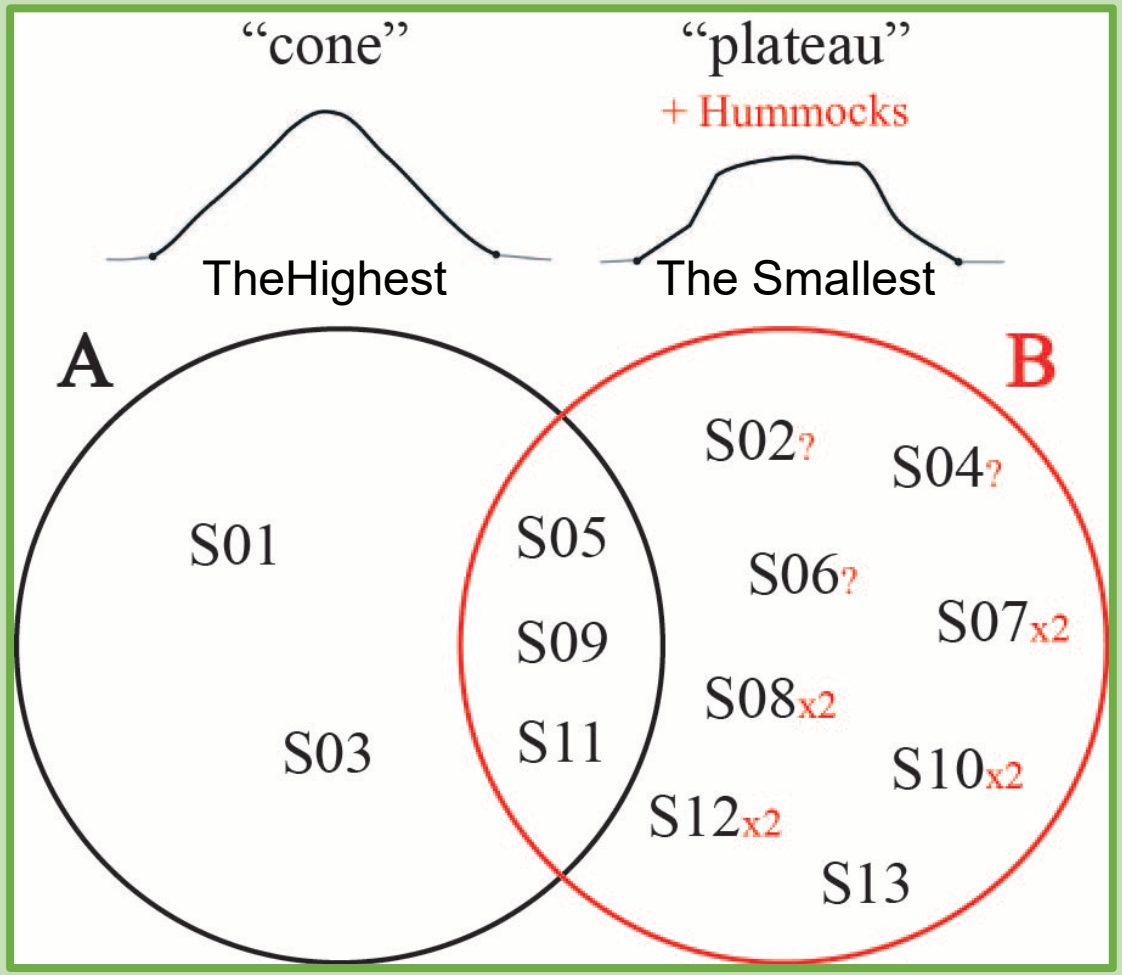
Discussions

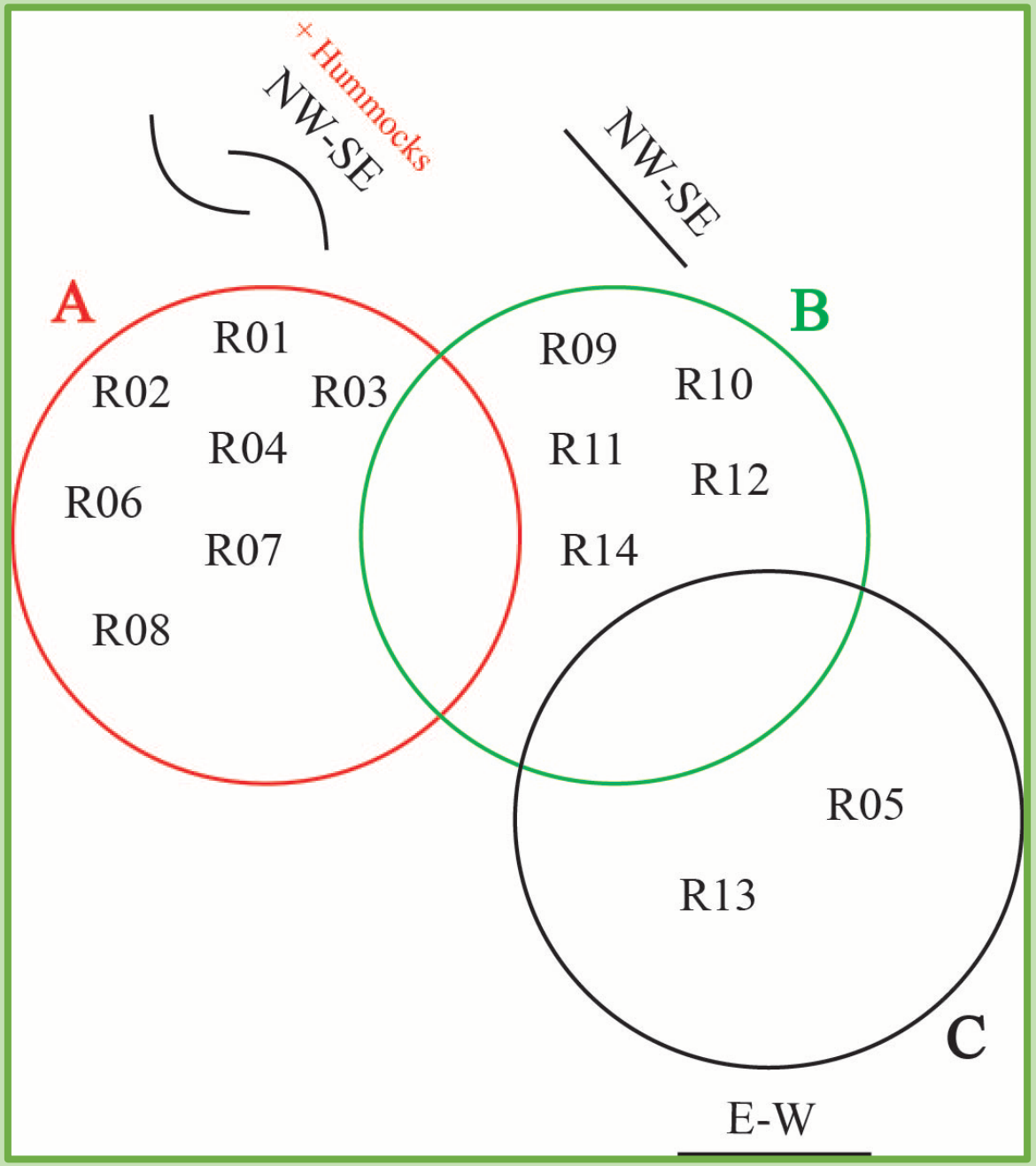




Discussions

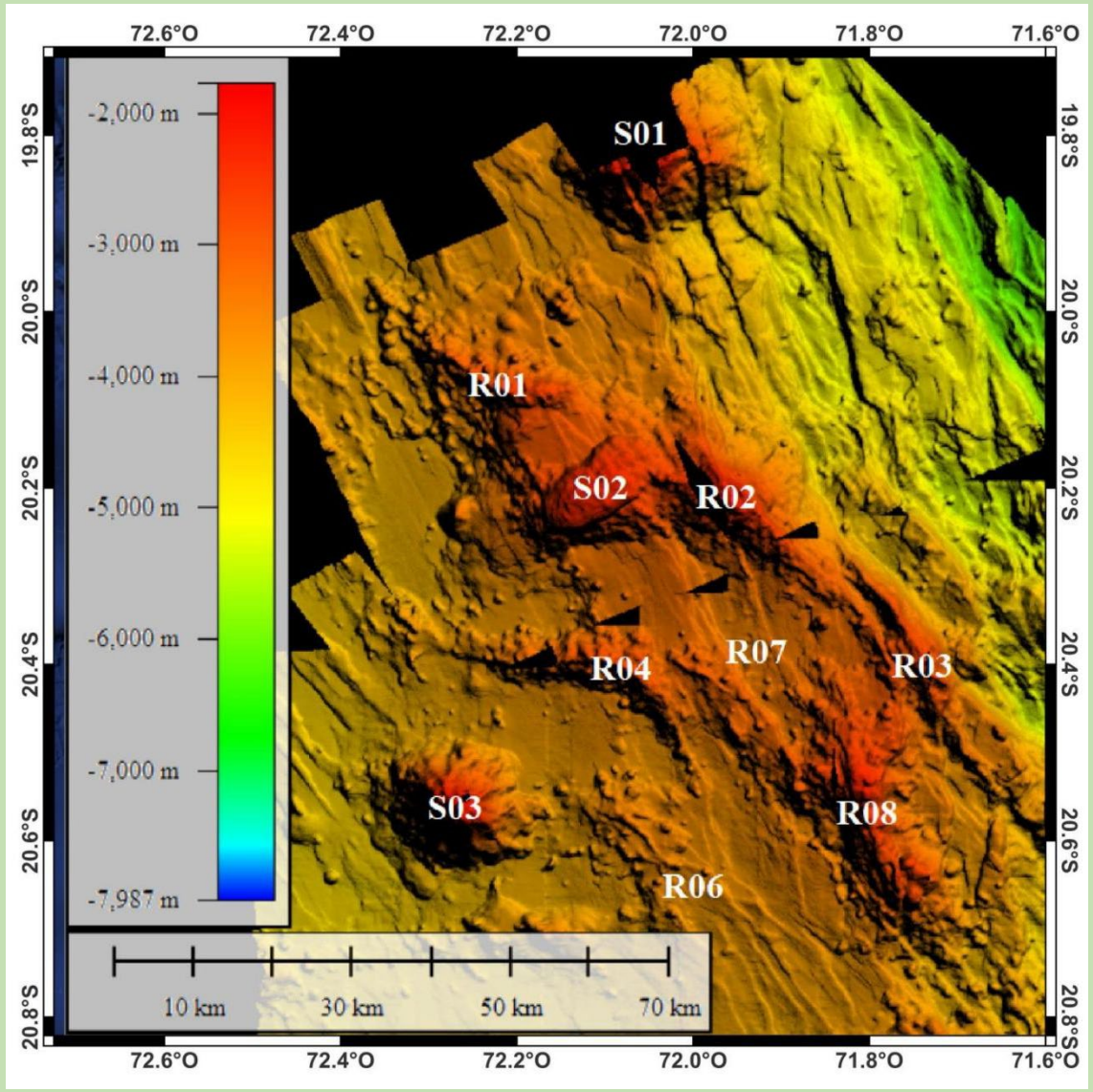
Seamounts & Local Ridges

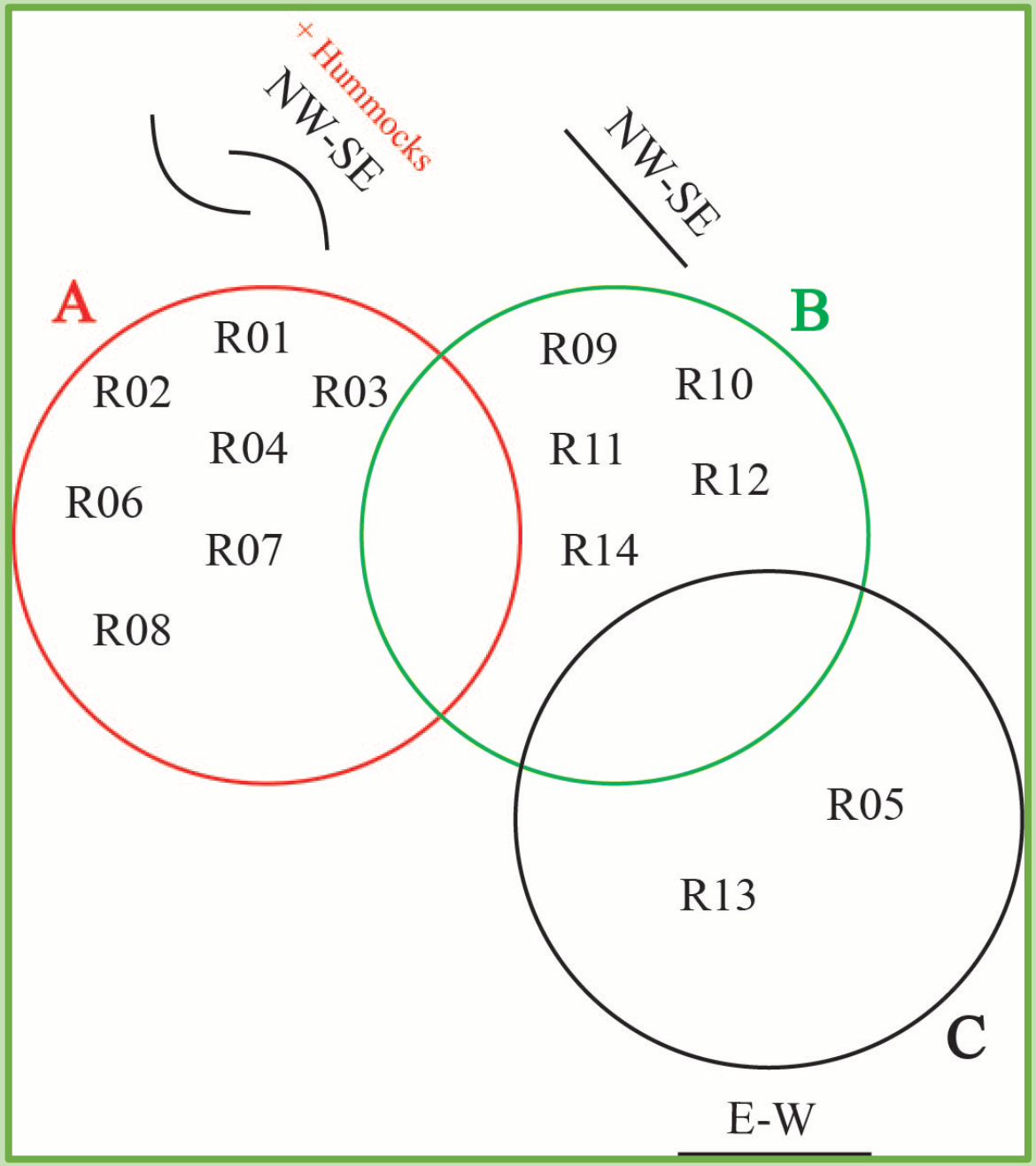




Discusiones

"Seamounts & Ridges"





Discusiones

"Seamounts & Ridges"